The Winter Sport Fisheries of Big Clear, Big Rideau, Big Salmon, Charleston and Devil Lakes, 1984.

Rideau Lakes
Fisheries Assessment Unit
Report No. 13

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Ministry of Natural Resources
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Depletion (of fish stocks) is not, as frequently understood a condition either of recent origin or of temporary nature. ... It would be better to consider depletion as a process and to understand how reduction of native stocks begins in the first place in order to appreciate the nature of the final stage... .

.....

This process has been going on (since early travellers and pioneer settlers first arrived)... . It has been assisted by almost every influence that has come about in the course of social and industrial progress. We have only to run through the list - deforestation, navigation facilities, water supply, pollution, power development, tourist trade and what not - to see how the process of fish extermination works.

.....

Viewing the matter historically, we have (in the southwestern portion of the province) ... a relatively small area which ... sustained ... the first shock of industrial development and depletion.

.....

While this development was going on, and during its advanced stages in the last century, the waters immediately along and to the northward of the pre-Cambrian line began to be accessible and also desirable from the summer visitor's point of view.

The waters involved were the Muskoka Lakes, to some extent the Georgian Bay and the magnificent lakes and streams of the Trent and Rideau systems, ... together with the upper reaches of the St. Lawrence River ... . It is the same waters, generally speaking, that are now in critical condition.

.....

Depletion is a process of long duration which can and in all Ontario situations is likely to be greatly accelerated (in the future).

- excerpt from Macdiarmid F., B.A. Bensley and C.A. Candee. 1930. Report of Special Committee on the Game Fish Situation. Legislative Assembly of Ontario Sessional Paper, No. 54. pp. 12-16. Printed and Published by Herbert H. Ball, Printer to the King's Most Excellent Majesty.

ABSTRACT

In February 1984 the Rideau Lakes Fisheries Assessment Unit conducted a creel census on Big Clear, Big Rideau, Big Salmon, Charleston and Devil Lakes.

The census was part of a long-term program designed to provide sport fishery information on these lake trout waters for trend-through-time analysis. Information requirements included:

(1) estimates of catch, harvest, effort and angler success rates,
(2) length, weight and age structures of the harvest,
(3) contribution of hatchery origin fish to the harvest,
(4) fishing methods and
(5) user group characteristics.

Results were interpreted in light of several indices of overexploitation, ie. relative yield index, total mortality, Abrosov index and growth. These indices did not allow any clear cut interpretation, however, the lake trout populations in all lakes showed signs of overexploitation.

Increases in CUE and yield indicate that the lake trout fishery in Big Clear Lake is recovering from prior overexploition. However, the continued decline of the Abrosov index and the increase in angler effort suggest that the increase will be short lived.

In Big Rideau Lake, trends in yield and CUE indicate that the lake trout fishery is relatively stable at present stocking rates and is in one of the intermediate stages of development.

The decline in mortality and the increases in yield and CUE suggest that the lake trout population in Big Salmon Lake is recovering from past overexploitation. However it is difficult to assess this population without a better understanding of the summer fishery.

In Charleston Lake the lake trout fishery seems to be stable at present stocking and effort rates, however, apparent declines in CUE warrant close monitoring.

The summer fishery is very important in Devil Lake, however the winter data seems to indicate that the trout population is in the late intermediate stage of development.

Data from Big Clear and Devil Lakes showed that lake trout caught on herring bait were significantly larger than trout caught on other baits.

The majority of anglers were local residents of Ontario.

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1. INTRODUCTION

In 1981, the Rideau Lakes Fisheries Assessment Unit (RLFAU) initiated a long-term creel census program to assess the sport fisheries of Big Clear, Big Rideau, Big Salmon, Charleston, and Devil Lakes during the winter and summer lake trout open seasons (MacLean and Smith 1981).

The program is designed to provide both qualitative and quantitative sport fishery data for trend-through-time analysis. Information to be gathered includes:

1) estimates of catch, harvest, effort, and angler success rates,
2) length, weight, and age structures of the harvest,
3) contribution of hatchery origin fish to the harvest,
4) fishing methods, and
5) user-group characteristics.

This report summarizes the results of the 1984 winter creel census and examines trends in light of several indices of overexploitation (Summer creel census on these five lakes is conducted only during odd-numbered years.)

2. THE STUDY AREA

The five RLFAU type lakes included in this study are situated along the Rideau Corridor (Figure 2.1) in Divisions 9 and 10 of the Ontario Fishery Regulations (Ontario Ministry of Natural Resources, MNR 1984a).

MacLean and Hooper (1981) examined the physical, chemical, and biological characteristics of each lake in detail. Table 2.1 presents a revised summary of this information. The area, mean depth, morphoedaphic index (MEI) and yield estimate for Big Rideau Lake have been recalculated.

Note: In 1983, a Fisheries Special Employment Project, co-ordinated through this office, repeated the lake survey mapping and depth sounding for all 10 Unit lakes. The values in Table 2.1 were adjusted only if the lake area calculation varied from background data by > 5%.

Table 2.1 Characteristics of the five study lakes (1984 revision).

Lake	Lake Community	Area	Mean Depth	TDS	T/O_2	MEI	Yield	Stresses Fishing	Stresses [AWPI
Big Clear Lake	1804	187.4	20.1	50	SHO	2.5	2.11	030	01000
Big Rideau Lake	3104	5761.0	13.3	138	SHO	10.4	4.02	032	00101
Big Salmon Lake	1804	148.1	13.2	59	SHO	4.5	2.75	020	01000
Charleston Lake	3004	2517.2	17.4	137	SHO	7.9	3.55	031	00111
Devil Lake	2204	1061.5	14.4	109	SLO	7.6	3.48	030	10100

Definition of columns:

Lake Community: First two columns = major community. 18 = lake trout-smallmouth bass; 22 = lake trout-northern pike-smallmouth bass; 30 = lake whitefish-northern pike-smallmouth bass; 31 = lake trout-lake whitefish-northern pike-smallmouth bass-walleye.

Last two columns = minor community. 04 = largemouth bass.

Area= surface in hectares (ha).

Mean depth= mean depth in metres (m).

TDS= total dissolved solids (mg/l) based on the lowest observed summer conductivity (Smith and MacLean 1984). TDS= 0.666 Cond. 25°C (Gale and Goodchild 1982).

T/O_2= temperature/oxygen; ie. SLO = stratified, low oxygen; SHO = stratified, high oxygen.

MEI= metric morphoedaphic index.

Yield= Ryder's annual yield estimate for Northern Great Lakes-St. Lawrence watershed (in kg/ha) (MNR 1982).

Stresses= Fishing: first column = no exploitation, second column = sport exploitation and third column = commercial exploitation; where 0 = non, 1 = low, 2 = medium and 3 = high.

Other: presence = 1 or absence = 0, of E = eutrophication, A = acidification, W = water levels, P = physical alterations and I = introductions. (Note: here introductions refer to exotic species. Various game fish have been successfully introduced to these waters in the past. All five lakes are presently stocked with lake trout.

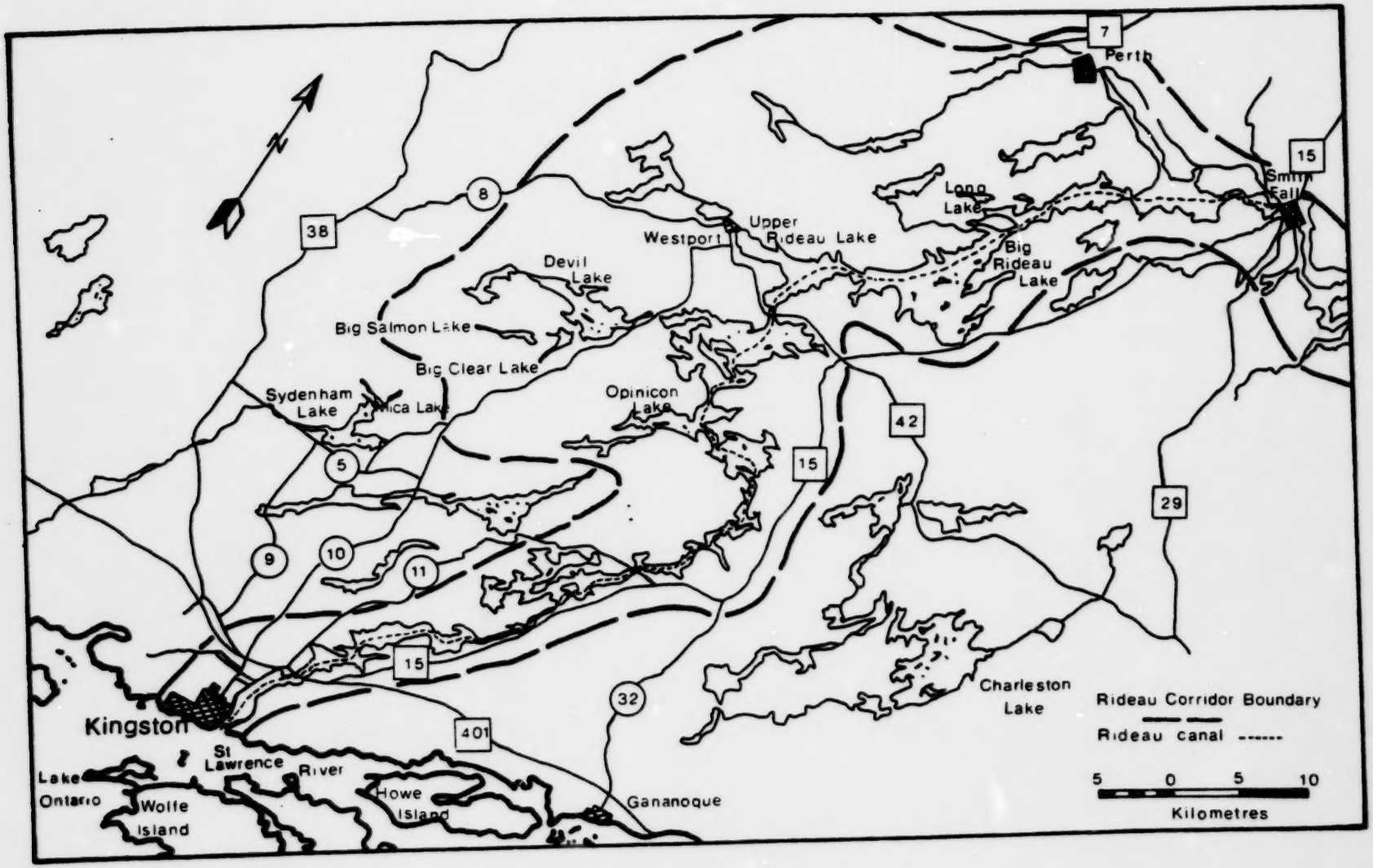

Figure 2.1 The Rideau Corridor and 10 RLFAU type lakes (after CORTS 1971).

3. METHODS

The RLFAU uses a roving creel methodology with spatial and temporal substratification. The CREESYS computer package (version 3.1) was used for data analysis (MNR 1984b). CREESYS produces the same results as the computerized data analysis program used by the RLFAU prior to 1984 (Barnes et al. 1984). Therefore, the results presented in this report are directly comparable to earlier RLFAU reports.

3.1 CREEL CENSUS DESIGN

The 1984 winter creel census was conducted during the lake trout open season from February 4 to 19. Basically, the census involved estimating fishing effort via angler counts, interviewing anglers, and sampling the harvest. The census was stratified by area, day-type and time-period (Table 3.1, Appendix 8.1).

Census days were scheduled so that three technicians could sample all five lakes. Weekend days were not stratified by time-period due to the short season. Two technicians each sampled two lakes readily accessible by snowmobile (Big Clear and Devil, or Big Rideau and Charleston Lakes) while a third skied into Frontenac Provincial Park to census Big Salmon Lake. Overall, 40% of available weekdays and 50% of available weekend-days were sampled on each lake.

3.2 CENSUS PROCEDURE

Pressure counts were carried out to determine the mean number of anglers present within specific strata. These counts, combined with interview information, provided estimates of catch, harvest and effort. Three counts were completed during most census periods: an instantaneous count for all areas, a progressive count after interviewing anglers in each area, and a final instantaneous count.

Angler interviews provided data on party size, fishing methods, angler origin and fishing success. The frequency of interviews per sampling period was not predetermined. Technicians organized their interview time to obtain the maximum number of random interviews in each area. Interview time per area was apportioned on the basis of the first instananeous count.

Scale samples, length and weight measurements, and fin clip data were collected randomly from harvested lake trout, walleye, northern pike and lake whitefish. Throughout this report, our use of common names follows Bailey et. al. (1970).

3.3 DATA ANALYSIS

3.3.1 Catch, harvest and effort estimates

The CREESYS computer program uses observed data to derive daily estimates of catch, harvest and effort. These estimated values are summed and expanded into stratum estimates (Appendix 8.2). (Note: In the following tables the sum of catch, harvest or effort estimates for individual strata does not always equal the combined strata estimates due to rounding error).

Standard errors (SE) for estimates of total catch, harvest and effort were calculated from the variability among daily estimates. The within-day variability was assumed to be small compared to the among day variability and was not included in the variance formula. A SE could not be calculated for any given stratum with less than two sample days. In such cases, a value of zero was arbitrarily assigned, resulting in an underestimated SE for any summary including this stratum.

Yield (as weight in kg) was calculated by multiplying the mean weight of the sample of a particular species by the estimated harvest. The variance of the product was calculated as:

$$S^2 = (x \cdot y)^2 \left(\frac{S_x^2}{x^2} + \frac{S_y^2}{y^2}\right)$$

where x and y are the mean weight and harvest respectively, having variances S_x^2 and S_y^2 (Freese 1979).

Catch-per-unit of effort (CUE) was expressed as the catch per rod-hour in both observed and estimated forms. Observed CUEs were calculated for "all anglers" by dividing the observed catch of a species by the observed total number of rod-hours expended by all anglers. Observed CUEs for "species-specific anglers" were calculated by dividing the observed catch of a species by the rod-hours expended by anglers seeking that particular species. (Throughout this report, the observed CUE may be used as a measure of relative abundance.)

Estimated CUEs were calculated for "all anglers" by dividing the total estimated catch of a species by the total estimated effort expended by all anglers, and for species-specific anglers by dividing the total estimated catch of a species by the total estimated effort expended by anglers seeking that particular species. The estimated CUEs were calculated to compensate for varying amounts of effort expended on each sampling day and are more representative of the general angling experience. Values for harvest-per-unit of effort (HUE) were also calculated in the above manner.

All statistical testing was done at the 95% significance level unless stated otherwise.

3.3.2 Age, length and weight

The age, fork length and weight distributions for all species sampled have been presented.

Recently, the scale method of age determination has come under considerable scrutiny, especially for slow-growing, coldwater species such as lake trout (Healey 1978; MNR 1983). Since the scale method was used to age all sampled fish in this study, further comment is appropriate at this point.

Verification of lake trout scale ages using other calcified structures has shown that, depending to some extent on growth rate, the scale method is inconsistent for lake trout of Ages VI to X and unreliable for older fish. However, the scale method is more reliable for heavily exploited populations, which usually contain young individuals that are growing rapidly due to growth compensation (MNR 1983).

Recent investigations using fin rays indicate that lake trout in the Rideau Lakes area are the fastest growing in Ontario from Ages I to X (A. Palilionis, J. Casselman, personal communications; RLFAU data). This can probably be attributed in part to intense exploitation. After Age X, growth slows considerably and ageing by scale annuli becomes increasingly unreliable. However scale-determined ages of almost all sampled hatchery origin lake tout of Age X or less were in agreement with ages determined from fin clip information. Thus, although the lake trout age structure data in this report should be treated with some caution until further validation, it is probably reliable up the Age X (MacLean et al. 1985).

3.3.3 Fishing methods and user-group data

During the winter lake trout open season, anglers may fish with one or two lines and a variety of bait-types and fishing methods are used. We tabulated the percent occurrence and observed CUE associated with each fishing method. Angler origin and accomodation type also have been reported. The classification scheme used for fishing methods and user-group data is reported in Smith (1981).

3.3.4 Observed yield in relation to potential yield

MNR (1983) suggested guidelines to partition the overall potential yield calculated from the MEI (Ryder 1965) into allowable commercial and angling yields. Exploitation levels were recommended for seven fish species including lake trout, northern pike, smallmouth bass, yellow perch and walleye. We have compared the recommended and actual percent exploitation levels and yields for each species and calculated both the relative yield index (RYI) (Adams and Olver 1977) and the ratio of observed to recommended yield (RORY) (Schlesinger and MacLean 1983).

Table 3.1 Design of the February 4-19, 1984 creel census.

Lake	Area	Season	Day-type	Time-period
Big Clear Lake	1,2	1	1,2	1,2
Big Rideau Lake	1,2,3,4	1	1,2	1,2
Big Salmon Lake	1,2,3	1	1,2	1,2
Charleston Lake	1,2,3,4,5	1	1,2	1,2
Devil Lake	1,2,3	1	1,2	1,2

Definition of columns:

Area: number = lake from Appendix 8.1

Season: 1 = February 4-19, 1984

Day-type: 1 = weekday; 2 = weekend-day

Time-period: 1 = 0700-1300h; 2 = 1300-1800h. Note: weekend days were not stratified due to sample size.

4. RESULTS AND DISCUSSION

4.1 BIG CLEAR LAKE

4.1.1 Winter creel census, 1984

One hundred and twenty-four anglers were interviewed during seven sampling days.

Distribution of angling effort- An estimated 7130 rod-hours (38.1 rod-hrs/ha) were exerted during the 16-day open season (Table 4.1). Area 1 received 61.3% of this effort (Table 4.2).

Weekend anglers accounted for 70.4% of the overall angling effort. The average weekend-day effort was four times greater than the average weekday effort. During weekdays, morning effort was 1.4 times afternoon effort. Weekend-days were not stratified by time period.

All angler effort was directed towards lake trout.

Total catch and harvest Lake trout was the only species observed during the census (Table 4.1).

The lake trout fishery- Lake trout anglers were marginally more successful in Area 1 than in Area 2 (Table 4.3). The observed CUE for both these areas combined was 0.127 trout/rod-hr. The observed HUE was 0.101 (Table 4.1). Overall an estimated 1094 lake trout were caught, of which 887 were harvested (Table 4.1).

The lake trout harvest consisted largely of Age IV-VI fish. Fourty-four percent of all sampled fish were of hatchery origin. Age, length, and weight distributions are depicted in Figs. 4.1-4.3 and mean values with 95% confidence limits are compared below.

Sample	n	Age (yr)	Total Length (cm)	Fork Length (cm)	Weight (g)
hatchery fish	30	5.1 +/- 0.4	35.4 +/- 2.3	32.3 +/- 2.1	339 +/- 68
native fish	38	4.9 +/- 0.5	39.2 +/- 3.3	35.6 +/- 3.0	601 +/-207
all fish	68	5.0 +/- 0.3	37.5 +/- 2.1	34.1 +/- 1.9	484 +/-121

The total estimated lake trout yield for the 1984 winter fishery was 2.29 +/- 1.02 kg/ha. The estimated yield of native lake trout was 1.59 kg/ha.

Fishing methods- The mean number of rods/angler was 1.93. The most common method was to fish with two lines; one line

jigged with an artificial/natural bait combination, the other line still-fished with a herring bait (Table 4.4). Although the mean age, weight and fork length of herring caught fish was larger than for fish caught on other baits, the differences were not significant (Students 't' test- age t=1.612, d.f.=67; fork length t=0.176, d.f.=67; weight t=0.745 , d.f.=67)(Table 4.5).

User group information- Ninety-two percent of anglers interviewed were local residents of Ontario (living within 50 km of Chaffey's Locks) and 8% were non-local Ontario residents. Ninety-nine percent of vistors interviewed were daytrippers.

4.1.2 Status of the fishery

Yield- The estimated total yield of naturally produced lake trout for the winter fishery was 1.59 kg/ha. This is 75% of the potential yield for all species (2.11 kg/ha/yr) and three times the recommended maximum yield for native lake trout (0.53 kg/ha/yr).

Biological characteristics of the lake trout harvest- Lake trout in Big Clear Lake apparently mature after reaching Age V (RLFAU 1981a,b). Since lake trout are fall spawners, trout taken during the winter open season at Age V or less will not have spawned for the first time. Therefore, an estimated 68% of the trout taken had never spawned (assuming that all fish spawn) (Fig. 4.1).

Approximately 44% of the fish harvested were of hatchery origin. Of these fish, the '78-'80 year classes were the most prominent in the harvest. The return of hatchery origin lake trout for the range of year classes represented in the 1984 winter harvest was 6.3% (Table 4.6).

Table 4.1 Summary of catch, harvest and effort data from the creel census conducted on Big Clear Lake during the February 4-19, 1984 lake trout open season. Values in parentheses are standard errors.

ALL ANGLERS

Species	# Anglers	OBSERVED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)	ESTIMATED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)
Lake trout	124	122	97	950	0.128	0.102	1094 (213)	887 (162)	7130 (773)	0.153	0.124
Lake herring	124	1	1	950	0.001	0.001	7 (5)	7 (5)	7130 (773)	0.001	0.001
Yellow perch	124	6	6	950	0.006	0.006	47 (33)	47 (33)	7130 (773)	0.006	0.006

SPECIES SPECIFIC ANGLERS

Species	# Anglers	OBSERVED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)	ESTIMATED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)
Lake trout	124	122	97	959	0.127	0.101	1094 (213)	887 (162)	7150 (759)	0.153	0.124

Table 4.2 Distribution of estimated angling effort (rod-hr) for all anglers by area, day-type, and time period during the February 4-19, 1984 lake trout open season on Big Clear Lake. Values in parentheses are percentages of the grand total.

Stratum	Weekday		Weekend-day[1]	Total
	AM	PM	AM + PM	
Area 1	795	615	2958	4368 (61.3)
Area 2	435	265	2062	2762 (38.7)
Entire Lake	1230 (17.3)	880 (12.3)	5020 (70.4)	7130 (100.0)
Entire Lake (AM + PM)	2110 (29.6)		5020 (70.4)	
Mean Daily Effort[2]	211.0		836.7	

[1] Weekend-days were not stratified by time period.

[2] The season included 10 weekdays and 6 weekend-days.

Table 4.3 Observed CUE and HUE for lake trout anglers and estimated lake trout catch and harvest for all anglers by area during the February 4-19, 1984 lake trout open season on Big Clear Lake. Values in parentheses are percentages of the total catch or harvest.

Parameter	Area 1	Area 2	Entire Lake
Observed CUE	0.129	0.123	0.127
Observed HUE	0.107	0.093	0.101
Estimated catch	674 (61.7)	419 (38.3)	109 (100.0)
Estimated harvest	550 (62.0)	337 (38.0)	887 (100.0)

Table 4.4 Percent occurence of and observed CUE associated with different lake trout angling method and bait-type combinations used during the February 4-19, 1984 lake trout open season on Big Clear Lake.
An asterisk denotes an impossible combination.
Blank spaces indicate no recorded effort.
CUE values associated with low percent occurence will tend to be less precise.

Bait Type[1]	Fishing Method[2]									
	Jig 1		Jig 2		Still 1		Still 2		Combination 2	
	Occ.	CUE	Occ.	CUE	Occ.	CUE	Occ.	CUE	Occ.	CUE
Herring					1.6	0.333	8.9	0.051		
Artificial										
Natural					2.4	0.186	12.1	0.187		
Art./Nat. Combination	4.8	0.103							2.4	0.860
Herring and Artificial	*				*				2.4	0.203
Herring and Natural	*				*		5.7	0.029	4.8	0.072
Artificial and Natural	*				*				0.8	0.444
Herring and Combination	*				*				27.4	0.133
Artificial and Combination	*				*				0.8	0.000
Natural and Combination	*				*		3.2	0.000	22.6	0.146

[1] Definition of bait-types: Herring=herring bait, angler fishing 1 or 2 lines; Artificial=artificial bait, 1 or 2 lines; Natural= natural bait, 1 or 2 lines; Art./Nat. Combination=combination of artificial and natural bait on same line, 1 or 2 lines; Herring and Artificial=1 line herring, 1 line artificial bait; Herring and Natural=1 line herring, 1 line natural bait; Artificial and Natural=1 line artificial, 1 line natural bait; Herring and Combination=1 line herring, 1 line artificial/natural bait; Artificial and Combination=1 line artificial, 1 line artificial/natural bait; Natural and Combination=1 line natural, 1 line artificial/natural bait.

[2] Definition of fishing methods: Jig 1=angler jigging with 1 line, no second line; Jig 2=angler jigging with 2 lines; Still 1=angler still fishing with 1 line, no second line; Still 2=angler still fishing with 2 lines; Combination 2=angler still fishing with 1 line, jigging with second.

Table 4.5 Summary of morphological data on lake trout caught on herring and other baits in Big Clear Lake, Febuary 4-19, 1984. Mean age, fork length and weight are given with 95% confidence limit.

Bait Type	n	Age (yrs)	Fork Length (cm)	Weight (g)
Herring	28	5.2 +/- 0.6	35.9 +/- 3.3	527 +/- 197
Other	42	4.8 +/- 0.3	33.0 +/- 2.1	458 +/- 137

Table 4.6 Return of stocked lake trout from the Big Clear Lake 1984 winter sport fishery. Values in parentheses denote percent of number stocked.

Year Class	Number Stocked	Stocking Rate (#/ha)	Estimated Winter Harvest
1977	1000	5.34	39 (3.9)
1978	2000	10.67	110 (5.5)
1979	700	3.74	110 (15.7)
1980	1500	8.00	121 (8.1)
1981	1500	8.00	16 (1.0)
Total	6200		391 (6.3)

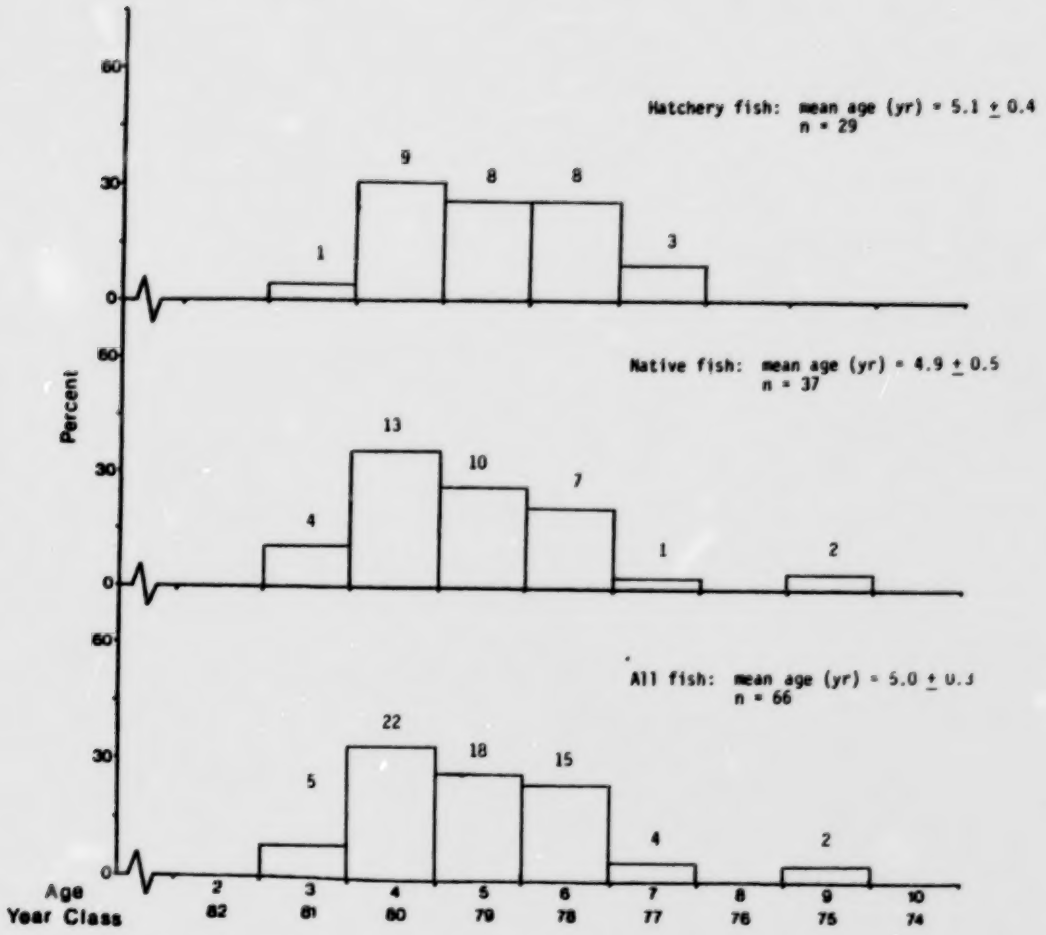

Figure 4.1 Age distributions of lake trout sampled during the winter 1984 sport fishery on Big Clear Lake. Numbers over each bar indicate actual count frequencies.

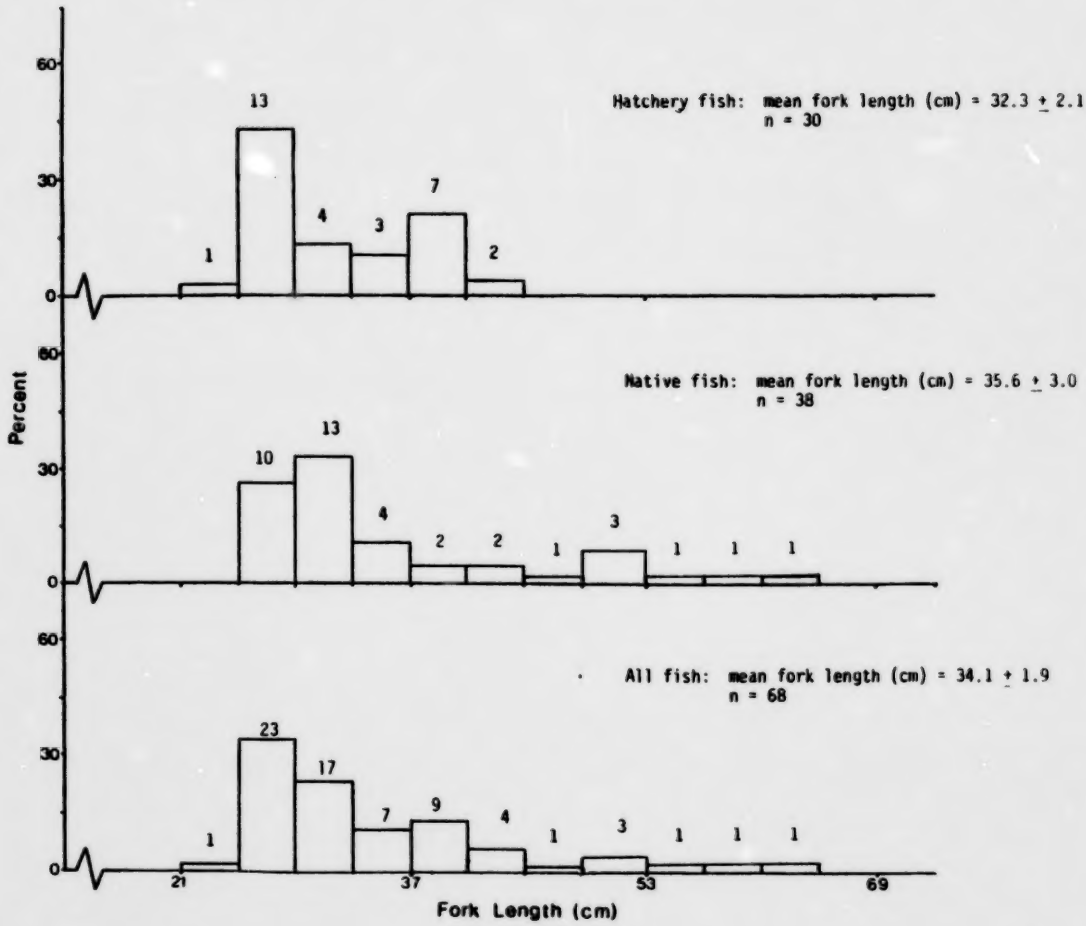

Figure 4.2 Fork length distributions of lake trout sampled during the winter 1984 sport fishery on Big Clear Lake.
Numbers over each bar indicate actual count frequencies.

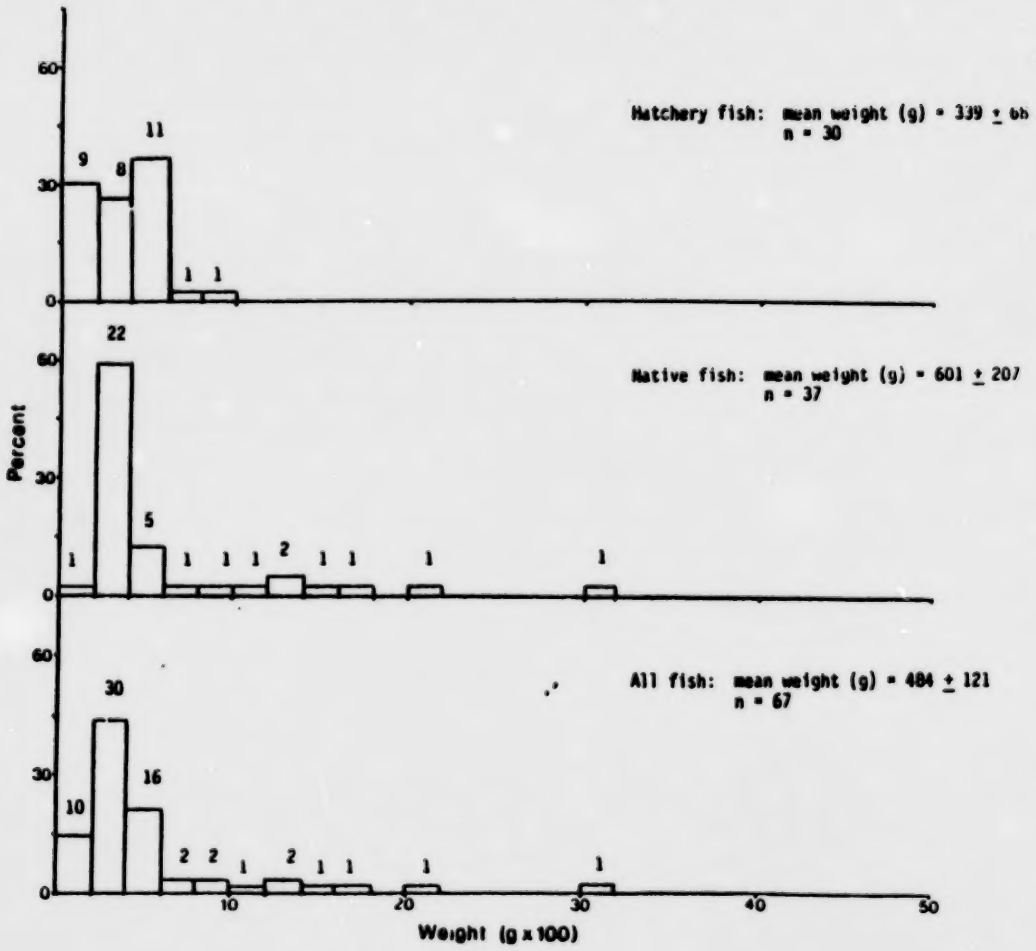
Hatchery fish: mean weight (g) = 339 ± 66
n = 30
Native fish: mean weight (g) = 601 ± 207
n = 37
All fish: mean weight (g) = 484 ± 121
n = 67
Percent
Weight (g x 100)

Figure 4.3 Weight distributions of lake trout sampled during the winter 1984 sport fishery on Big Clear Lake. Numbers over each bar indicate actual count frequencies.

4.2 BIG RIDEAU LAKE

4.2.1 Winter creel census, 1984

One hundred and ninety-eight anglers were interviewed during seven sampling days.

Distribution of angling effort- An estimated 28957 rod-hours (5.03 rod-hrs/ha) were exerted during the 16-day open season (Table 4.7). Area 2 received the greatest angling effort of all of the areas (37.9% of total) (Table 4.8).

Weekend anglers accounted for 67.5% of the overall angling effort. The average weekend-day effort was 3.5 times greater than the average weekday effort. During weekdays, morning effort was 2.4 times afternoon effort. Weekend-days were not stratified by time period.

All anglers sought lake trout.

Total catch and harvest- Lake trout, lake whitefish, lake herring, northern pike, burbot and yellow perch were all observed during the census (Table 4.7). Of the estimated 4069 fish of all species caught, 88% were lake trout. None of the other species comprised more than 4% of the total catch.

The lake trout fishery- Lake trout anglers were marginally most successful in Area 4 and least successful in Area 1 (Table 4.9). The observed CUE for all areas combined was 0.102 trout/rod-hr. The observed HUE was 0.067 (Table 4.9). Overall an estimated 3567 lake trout were caught, of which 2390 were harvested (Table 4.7).

The lake trout harvest consisted largely of Age IV-V fish. Sixty-six percent of all sampled fish were of hatchery origin. Age, length, and weight frequency distributions are depicted in Figs. 4.4-4.6 and mean values with 95% confidence limits are compared below.

Sample	n	Age (yr)	Total Length (cm)	Fork Length (cm)	Weight (g)
hatchery fish	27	4.7 +/- 0.4	43.3 +/- 4.3	39.6 +/- 3.9	780 +/- 297
native fish	14	5.1 +/- 0.7	47.0 +/- 6.6	42.9 +/- 6.1	1123 +/-717
all fish	41	4.9 +/- 0.4	44.5 +/- 3.4	40.7 +/- 3.1	900 +/- 241

The total estimated lake trout yield for the 1984 winter fishery was 0.38 +/- 0.17 kg/ha. The estimated yield of native lake trout was 0.17 kg/ha.

Fishing methods- The mean number of rods/angler was 1.45. The most common fishing method was to jig with one line with artificial bait (Table 4.10). Only one lake trout was caught on herring bait.

User group information- Eighty-one percent of anglers interviewed were local residents of Ontario (living within 50 km of Chaffey's Locks), 18% were non-local Ontario residents, and 1% were non-Ontario Canadian residents. Ninety-two percent of visitors were daytrippers, 5% stayed at non-commercial accomodation and 2% paid for their accomodation.

4.2.2 Status of the fishery

Yield- The estimated total yield of native lake trout for the winter fishery was 0.17 kg/ha. This is 4% of the potential annual yield for all species (4.15 kg/ha/yr) and 16% of the recommended maximum yield for the native lake trout (1.04 kg/ha/yr).

Biological characteristics of the lake trout harvest- Lake trout in Big Rideau Lake apparently mature after reaching Age V (RLFAU 1981a,b). Since lake trout are fall spawners, trout taken during the winter open season at Age V or less will not have spawned for the first time. Therefore, an estimated 83% of the trout taken had never spawned (assuming that all fish spawn) (Fig. 4.4).

Approximately 66% of the fish harvested were of hatchery origin. Of these fish, the '78-'80 year classes were the most prominent in the harvest. The return of hatchery origin lake trout for the range of year classes represented in the 1984 winter harvest was 1.5% (Table 4.11).

Table 4.7 Summary of catch, harvest and effort data from the creel census conducted on Big Rideau Lake during the February 4-19, 1984 lake trout open season. Values in parentheses are standard errors.

ALL ANGLERS

Species	# Anglers	OBSERVED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)	ESTIMATED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)
Lake trout	198	115	75	1109	0.103	0.068	3567 (510)	2397 (424)	28957 (3827)	0.123	0.083
Lake whitefish	198	2	2	1109	0.001	0.001	101 (58)	101 (58)	28957 (3827)	0.003	0.003
Lake herring	198	8	8	1109	0.007	0.007	172 (77)	172 (77)	28957 (3827)	0.005	0.005
Northern pike	198	3	3	1109	0.002	0.002	69 (33)	69 (33)	28957 (3827)	0.002	0.002
Burbot	198	4	4	1109	0.003	0.003	81 (37)	81 (37)	28957 (3827)	0.002	0.002
Yellow perch	198	2	1	1109	0.001	0.001	79 (59)	39 (28)	28957 (3827)	0.002	0.002

SPECIES SPECIFIC ANGLERS

Species	# Anglers	OBSERVED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)	ESTIMATED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)
Lake trout	198	115	75	1123	0.102	0.067	3567 (510)	2390 (424)	28986 (3819)	0.123	0.082

Table 4.8 Distribution of estimated angling effort (rod-hr) for all anglers by area, day-type, and time period during the February 4 19, 1984 lake trout open season on Big Rideau Lake. Values in parentheses are percentages of the grand total.

Statum	Weekday		Weekend-day[1]	Total
	AM	PM	AM + PM	
Area 1	2055	275	5494	7824 (27.0)
Area 2	2770	930	7272	10972 (37.9)
Area 3	1420	1060	4484	6964 (24.0)
Area 4	435	450	2312	3197 (11.0)
Entire lake	6680 (23.1)	2735 (9.4)	19542 (67.5)	28957 (100.0)
Entire lake (AM + PM)	9415 (32.5)		19542 (67.5)	
Mean daily effort[2]	941.5		3257.0	

[1] Weekend-days were not stratified by time period.

[2] The season included 10 weekdays and 6 weekend-days.

Table 4.9 Observed CUE and HUE for lake trout anglers and estimated lake trout catch and harvest for all anglers by area during the February 4-19, 1984 lake trout open season on Big Rideau Lake. Values in parentheses are percentages of the total catch or harvest.

Parameter	Area				Entire Lake
	1	2	3	4	
Observed CUE	0.015	0.067	0.163	0.203	0.127
Observed HUE	0.013	0.048	0.109	0.119	0.067
Estimated catch	185 (5.2)	640 (17.9)	1828 (51.2)	912 (25.6)	3567 (100.0)
Estimated harvest	157 (6.6)	526 (22.0)	1216 (50.9)	490 (20.5)	2390 (100.0)

Table 4.10 Percent occurence of and observed CUE associated with different lake trout angling method and bait-type combinations used during the February 4-19, 1984 lake trout open season on Big Rideau Lake.
An asterisk denotes an impossible combination.
Blank spaces indicate no recorded effort.
CUE values associated with low percent occurence will tend to be less precise.

Bait Type[1]	Fishing Method[2]									
	Jig 1		Jig 2		Still 1		Still 2		Combination 2	
	Occ.	CUE	Occ.	CUE	Occ.	CUE	Occ.	CUE	Occ.	CUE
Herring							0.5	0.000		
Artificial	38.7	0.190	7.0	0.057						
Natural							0.5	0.000		
Art./Nat. Combination	17.6	0.066	7.5	0.037						
Herring and Artificial	*				*				7.5	0.(xx
Herring and Natural	*				*					
Artificial and Natural	*				*				6.5	0.110
Herring and Combination	*				*				2.0	0.014
Artificial and Combination	*		1.0	0.182	*					
Natural and Combination	*				*				10.1	0.047

[1] Definition of bait-types: Herring=herring bait, angler fishing 1 or 2 lines; Artificial=artificial bait, 1 or 2 lines; Natural= natural bait, 1 or 2 lines; Art./Nat. Combination=combination of artificial and natural bait on same line, 1 or 2 lines; Herring and Artificial=1 line herring, 1 line artificial bait; Herring and Natural=1 line herring, 1 line natural bait; Artificial and Natural=1 line artificial, 1 line natural bait; Herring and Combination=1 line herring, 1 line artificial/natural bait; Artificial and Combination=1 line artificial, 1 line artificial/natural bait; Natural and Combination=1 line natural, 1 line artificial/natural bait.

[2] Definition of fishing methods: Jig 1=angler jigging with 1 line, no second line; Jig 2=angler jigging with 2 lines; Still 1=angler still fishing with 1 line, no second line; Still 2=angler still fishing with 2 lines; Combination 2=angler still fishing with 1 line, jigging with second.

Table 4.11 Return of stocked lake trout from the Big Rideau Lake 1984 winter sport fishery.
Values in parentheses denote percent of number stocked.

Year Class	Number Stocked	Stocking Rate (#/ha)	Estimated Winter Harvest
1976	20000	3.09	63 (0.3)
1977	15000	2.31	0
1978	18986	2.93	189 (1.0)
1979	16422	2.53	567 (3.5)
1980	17606	2.72	693 (3.9)
1981	17606	2.72	63 (0.4)
Total	105620		1574 (1.5)

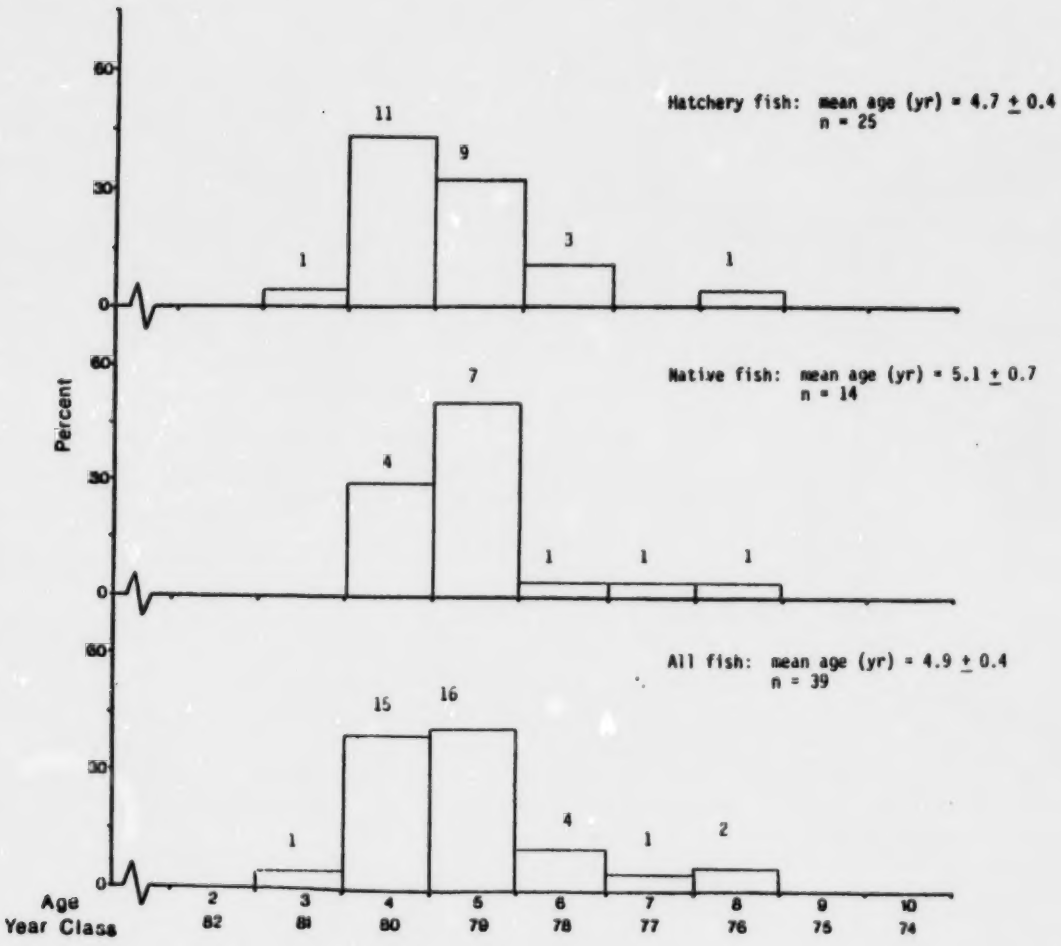

Figure 4.4 Age distributions of lake trout sampled during the winter 1984 sport fishery on Big Rideau Lake. Numbers over each bar indicate actual count frequencies.

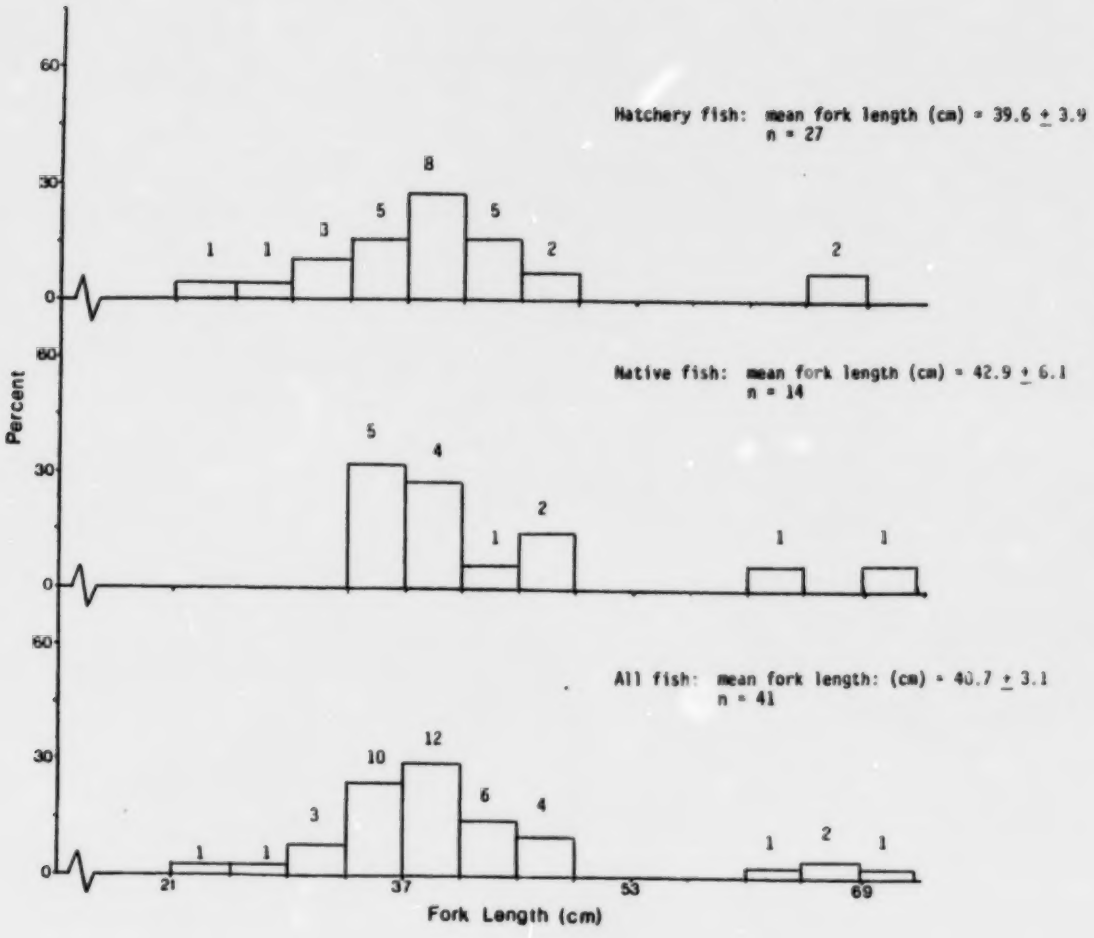

Figure 4.5 Fork length distributions of lake trout sampled during the winter 1984 sport fishery on Big Rideau Lake.
Numbers over each bar indicate actual count frequencies.

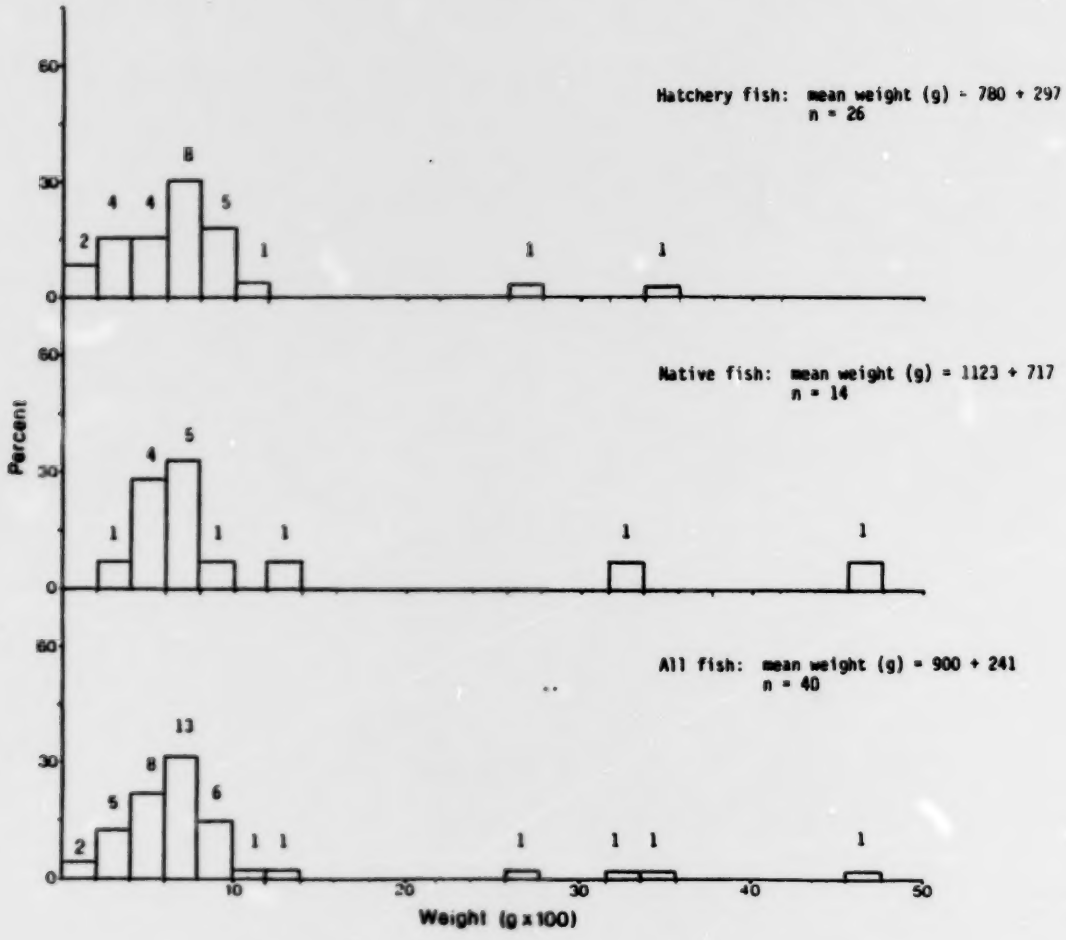

Figure 4.6 Weight distributions of lake trout sampled during the winter 1984 sport fishery on Big Rideau Lake. Numbers over each bar indicate actual count frequencies.

4.3 BIG SALMON LAKE

4.3.1 Winter creel census, 1984

One hundred and twenty-eight anglers were interviewed during seven sampling days.

Distribution of angling effort- An estimated 5010 rod-hours (33.8 rod-hrs/ha) were exerted during the 16-day open season (Table 4.12). Area 2 received 77.0% of this effort (Table 4.13).

Weekend anglers accounted for 54.7% of the overall angling effort. The average weekend-day effort was 2.0 times greater than the average weekday effort. During weekdays, morning effort was 2.0 times afternoon effort. Weekend-days were not stratified by time period.

All angler effort was directed towards lake trout.

Total catch and harvest- Lake trout and lake herring were the only species observed during the census. Lake herring made up less than 1% of the total number of fish caught (Table 4.12).

The lake trout fishery- Lake trout anglers were far less successful in Area 3 than in the other two areas (Table 4.13). The observed CUE for all areas combined was 0.125 trout/rod-hr. The observed HUE was 0.094 (Table 4.13). Overall an estimated 665 lake trout were caught, of which 513 were harvested (Table 4.12).

Fifty-four percent of the lake trout harvest consisted of Age IV and V fish. Fifty-nine percent of all sampled fish were of hatchery origin. Age, length, and weight frequency distributions are depicted in Figs. 4.7-4.9 and mean values with 95% confidence limits are compared below.

Sample	n	Age (yr)	Total Length (cm)	Fork Length (cm)	Weight (g)
hatchery fish	30	6.3 +/- 0.7	38.8 +/- 3.9	36.0 +/- 3.5	556 +/- 205
native fish	21	5.4 +/- 0.8	40.0 +/- 6.3	37.4 +/- 6.0	825 +/- 581
all fish	51	5.9 +/- 0.5	39.3 +/- 3.3	36.6 +/- 3.1	667 +/- 257

The total estimated lake trout yield for the 1984 winter fishery was 2.31 +/- 1.18 kg/ha. The estimated yield of native lake trout was 1.18 kg/ha.

Fishing methods- The mean number of rods/angler was 1.90. The most common method was to fish with two lines; one line jigged with an artificial/natural bait combination, the other

line still-fished with a herring bait (Table 4.15). The mean age, weight and fork length of herring caught lake trout were not significantly greater than those of trout caught on other baits (Student's 't' test- age t=0.577, d.f.=51; fork length t=1.325, d.f.=51; weight t=1.450, d.f.=51)(Table 4.16).

User Group Information- Ninety-one percent of anglers interviewed were local residents of Ontario (living within 50 km of Chaffey's Locks) and 9% were non-local Ontario residents. Ninety-five percent of visitors interviewed were daytrippers, and 5% were campers at a provincial park.

4.3.2 Status of the fishery

Yield- The estimated total yield of naturally produced lake trout for the winter fishery was 1.18 kg/ha. This is 43% of the annual potential yield for all species (2.75 kg/ha/yr) and 172% the recommended maximum yield for the native lake trout (0.69 kg/ha/yr).

Biological characteristics of the lake trout harvest- Lake trout in Big Salmon Lake apparently mature after reaching Age V (RLFAU 1981a,b). Since lake trout are fall spawners, trout taken during the winter open season at Age V or less will not have spawned for the first time. Therefore, an estimated 56% of the trout taken had never spawned (assuming that all fish spawn) (Fig. 4.7).

Approximately 55% of the fish harvested were of hatchery origin. The return of hatchery origin lake trout for the range of year classes represented in the 1984 winter harvest was 3.7% (Table 4.17).

Table 4.12 Summary of catch, harvest and effort data from the creel census conducted on Big Salmon Lake during the February 4-19, 1984 lake trout open season. Values in parentheses are standard errors.

ALL ANGLERS

Species	# Anglers	OBSERVED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)	ESTIMATED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)
Lake trout	128	126	94	998	0.126	0.094	665 (129)	513 (653)	5010 (653)	0.132	0.102
Lake herring	128	1	1	998	0.001	0.001	3 (2)	3 (2)	5010 (653)	0.000	0.000

SPECIES SPECIFIC ANGLERS

Species	# Anglers	OBSERVED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)	ESTIMATED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)
Lake trout	128	126	94	1004	0.125	0.094	665 (129)	513 (83)	5024 (643)	0.132	0.102

Table 4.13 Distribution of estimated angling effort (rod-hr) for all anglers by area, day-type, and time period during the February 4-19, 1984 lake trout open season on Big Salmon Lake. Values in parentheses are percentages of the grand total.

Statum	Weekday		Weekend-day[1]	Total
	AM	PM	AM + PM	
Area 1	60	0	88	148 (3.0)
Area 2	1115	560	2184	3859 (77.0)
Area 3	340	195	468	1003 (20.0)
Entire Lake	1515 (30.2)	755 (15.1)	2740 (54.7)	5010 (100.0)
Entire Lake (AM + PM)	2270 (45.3)		2740 (54.7)	
Mean Daily Effort[2]	227		456.7	

[1] Weekend-days were not stratified by time period.

[2] The season included 10 weekdays and 6 weekend-days.

Table 4.14 Observed CUE and HUE for lake trout anglers and estimated lake trout catch and harvest for all anglers by area during the February 4-19, 1984 lake trout open season on Big Salmon Lake. Values in parentheses are percentages of the total catch or harvest.

Parameter	Area			Entire Lake
	1	2	3	
Observed CUE	0.149	0.152	0.041	0.125
Observed HUE	0.149	0.110	0.041	0.094
Estimated catch	29 (4.4)	585 (88.0)	51 (7.7)	665 (100.0)
Estimated harvest	29 (5.7)	433 (84.4)	51 (9.9)	513 (100.0)

Table 4.15 Percent occurence of and observed CUE associated with different lake trout angling methods and bait-type combinations used during the February 4-19, 1984 lake trout open season on Big Salmon Lake.
An asterisk denotes an impossible combination.
Blank spaces indicate no recorded effort.
CUE values associated with low percent occurence will tend to be less precise.

Bait Type[1]	Fishing Method[2]									
	Jig 1		Jig 2		Still 1		Still 2		Combination 2	
	Occ.	CUE	Occ.	CUE	Occ.	CUE	Occ.	CUE	Occ.	CUE
Herring					0.8	0.000	14.2	0.060		
Artificial	2.3	0.000					0.8	0.000		
Natural					1.6	0.066	6.3	0.031		
Art./Nat. Combination	5.5	0.308								
Herring and Artificial	*				*				4.7	0.045
Herring and Natural	*				*		5.5	0.051		
Artificial and Natural	*				*					
Herring and Combination	*				*		0.8	0.250	40.2	0.164
Artificial and Combination	*				*				0.8	0.000
Natural and Combination	*				*				16.5	0.137

[1] Definition of bait-types: Herring=herring bait, angler fishing 1 or 2 lines; Artificial=artificial bait, 1 or 2 lines; Natural= natural bait, 1 or 2 lines; Art./Nat. Combination=combination of artificial and natural bait on same line, 1 or 2 lines; Herring and Artificial=1 line herring, 1 line artificial bait; Herring and Natural=1 line herring, 1 line natural bait; Artificial and Natural=1 line artificial, 1 line natural bait; Herring and Combination=1 line herring, 1 line artificial/natural bait; Artificial and Combination=1 line artificial, 1 line artificial/natural bait; Natural and Combination=1 line natural, 1 line artificial/natural bait.

[2] Definition of fishing methods: Jig 1=angler jigging with 1 line, no second line; Jig 2=angler jigging with 2 lines; Still 1=angler still fishing with 1 line, no second line; Still 2=angler still fishing with 2 lines; Combination 2=angler still fishing with 1 line, jigging with second.

Table 4.16 Summary of morphological data on lake trout caught on herring bait and other baits in Big Salmon Lake, Febuary 4-19, 1984. Mean age, fork length and weight are given with 95% confidence limit.

Bait Type	n	Age (yrs)	Fork Length (cm)	Weight (g)
Herring	31	6.1 +/- 0.8	38.3 +/- 4.8	837 +/- 422
Other	20	5.7 +/- 0.8	33.8 +/- 3.0	404 +/- 146

Table 4.17 Return of stocked lake trout from the Big Salmon Lake 1984 winter sport fishery.
Values in parentheses denotes percent of number stocked.

Year Class	Number Stocked	Stocking Rate (#/ha)	Estimated Winter Harvest
1975	2050	13.84	54 (2.6)
1976	2050	13.84	42 (2.1)
1977	1000	6.75	42 (4.2)
1978	1475	9.96	30 (2.0)
1979	625	4.22	54 (8.6)
1980	1000	6.75	76 (7.6)
Total	8200		302 (3.7)

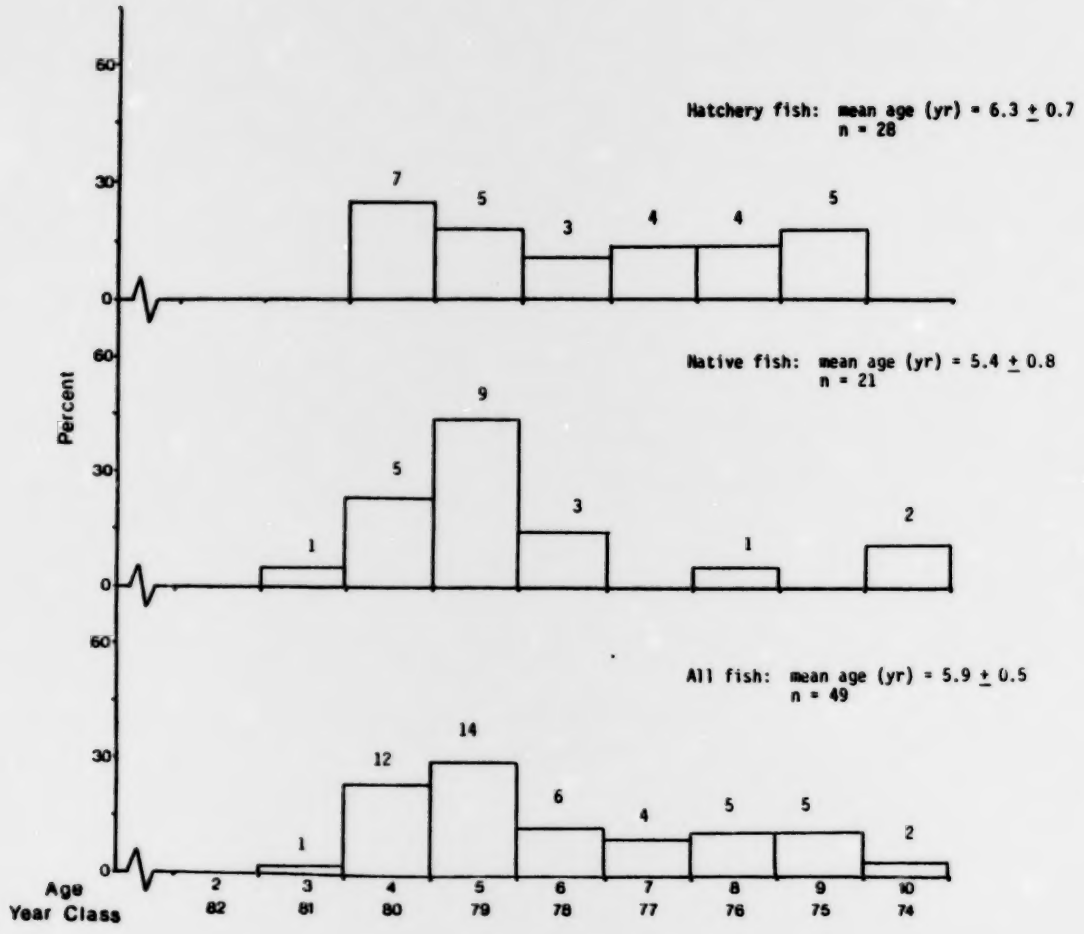

Figure 4.7 Age distributions of lake trout sampled during the winter 1984 sport fishery on Big Salmon Lake. Numbers over each bar indicate actual count frequencies.

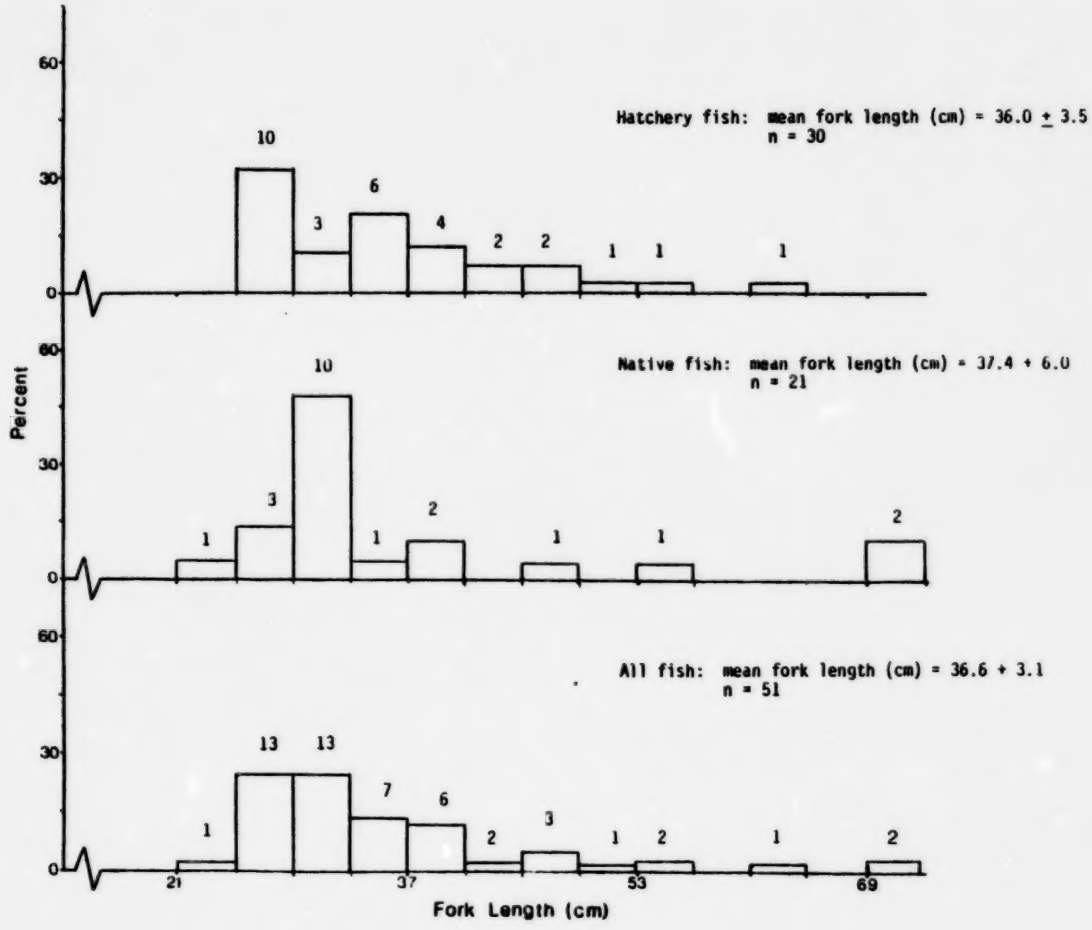

Figure 4.8 Fork length distributions of lake trout sampled during the winter 1984 sport fishery on Big Salmon Lake.
Numbers over each bar indicate actual count frequencies.

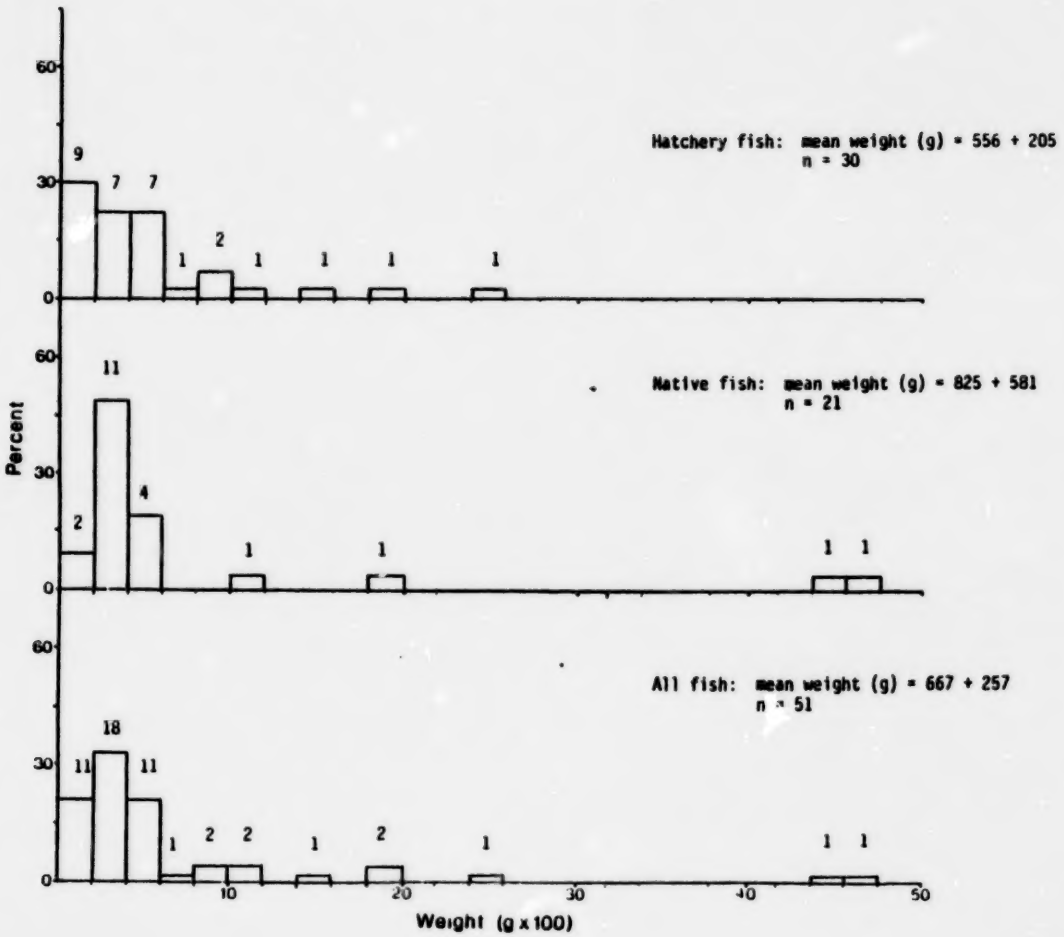

Figure 4.9 Weight distributions of lake trout sampled during the winter 1984 sport fishery on Big Salmon Lake. Numbers over each bar indicate actual count frequencies.

4.4 CHARLESTON LAKE

4.4.1 Winter creel census, 1984

One hundred and ninety-six anglers were interviewed during seven sampling days.

Distribution of angling effort- An estimated 27351 rod-hours (10.9 rod-hrs/ha) were exerted during the 16-day open season (Table 4.18).\ Area 2 received 57.4% of this effort (Table 4.19).

Weekend anglers accounted for 72.7% of the overall angling effort. The average weekend-day effort was 4.4 times greater than the average weekday effort. During weekdays, morning effort was 1.5 times afternoon effort. Weekend-days were not stratified by time period.

All angler effort was directed towards lake trout.

Total catch and harvest- Lake trout, lake herring, and burbot were observed during the census. Lake trout made up 96% of the total number of fish caught (Table 4.18).

The lake trout fishery- Lake trout anglers were most successful in Area 5 and least successful in Area 1 (Table 4.20). The observed CUE for all the areas combined was 0.181 trout/rod-hr. The observed HUE was 0.134 (Table 4.20). Overall an estimated 5348 lake trout were caught, of which 3835 were harvested (Table 4.18).

The lake trout harvest consisted mostly of Age IV to VI fish. Sixty-eight percent of all sampled fish were of hatchery origin. Age, length, and weight frequency distributions are depicted in Figs. 4.10- 4.12 and mean values with 95% confidence limits are compared below.

Sample	n	Age (yr)	Total Length (cm)	Fork Length (cm)	Weight (g)
hatchery fish	30	5.0 +/- 0.5	41.1 +/- 2.9	37.9 +/- 2.7	627 +/- 180
native fish	14	5.6 +/- 0.8	47.9 +/- 6.8	44.2 +/- 6.3	1201 +/-654
all fish	44	5.2 +/- 0.4	43.3 +/- 3.0	39.9 +/- 2.8	810 +/- 250

The total estimated lake trout yield for the 1984 winter fishery was 1.23 +/- 0.53 kg/ha. The estimated yield of native lake trout was 0.58 kg/ha.

Fishing methods- The mean number of rods/angler was 1.35. The most common method was to jig with one line using artificial bait (Table 4.21). Only four lake trout were caught on herring bait. Their mean age (+/- 95% CL) was 5.5 +/- 9.4 yr,

mean fork length was 41.4 +/- 9.4 cm and mean weight was 317 +/- 504 g.

User group information- Ninety-one percent of anglers interviewed were local residents of Ontario (living within 50 km of Chaffey's Locks) and 9% were non-local Ontario residents. Ninety-seven percent of vistors interviewed were day trippers and 2% stayed at non-commercial accomodation.

4.4.2 Status of the fishery

Yield- The estimated total yield of naturally produced lake trout for the winter fishery was 0.58 kg/ha. This is 16% of the potential annual yield for all species (3.55 kg/ha/yr) and 65% of the recommended maximum yield for the native lake trout (0.89 kg/ha/yr.

Biological characteristics of the lake trout harvest- Lake trout in Charleston Lake apparently mature after reaching Age V (RLFAU 1981a,b). Since lake trout are fall spawners, trout taken during the winter open season at Age V or less will not have spawned for the first time. Therefore, an estimated 74% of the trout taken had never spawned (assuming that all fish spawn) (Fig. 4.12).

Approximately 68% of the fish harvested were of hatchery origin. The return of hatchery origin lake trout for the range of year classes represented in the 1982 winter harvest was 1.9% (Table 4.22).

Table 4.18 Summary of catch, harvest and effort data from the creel census conducted on Charleston Lake during the February 4-19, 1984 lake trout open season. Values in parentheses are standard errors.

ALL ANGLERS

Species	OBSERVED						ESTIMATED				
	# Anglers	Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)	Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)
Lake trout	196	186	137	1005	0.185	0.136	5348 (861)	3835 (562)	27351 (3374)	0.195	0.140
Lake herring	196	6	6	1005	0.005	0.005	96 (28)	96 (28)	27351 (3374)	0.003	0.003
Burbot	196	1	1	1005	0.000	0.000	9 (8)	9 (8)	27351 (3374)	0.000	0.000

SPECIES SPECIFIC ANGLERS

Species	OBSERVED						ESTIMATED				
	# Anglers	Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)	Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)
Lake trout	196	186	137	1022	0.181	0.134	5348 (861)	3835 (562)	27388 (3365)	0.195	0.140

Table 4.19 Distribution of estimated angling effort (rod-hr) for all anglers by area, day-type, and time period during the February 4-19, 1984 lake trout open season on Charleston Lake. Values in parentheses are percentages of the grand total.

Stratum	Weekday		Weekend-day[1]	Total
	AM	PM	AM + PM	
Area 1	320	155	1612	2087 (7.6)
Area 2	2630	2105	10976	15711 (57.4)
Area 3	450	215	1628	2293 (8.4)
Area 4	365	375	1520	2260 (8.3)
Area 5	760	90	4150	5000 (18.3)
Entire lake	4525 (16.5)	2940 (10.7)	19886 (72.7)	27351 (100.0)
Entire lake (AM + PM)	7465 (27.3)		19886 (72.7)	
Mean daily effort[2]	746.5		3314.3	

[1] Weekend-days were not stratified by time period.

[2] The season included 10 weekdays and 6 weekend-days.

Table 4.20 Observed CUE and HUE for lake trout anglers and estimated lake trout catch and harvest for all anglers by area during the February 4-19, 1984 lake trout open season on Charleston Lake. Values in parentheses are percentages of the total catch or harvest.

Parameter	Area					Entire Lake
	1	2	3	4	5	
Observed CUE	0.138	0.146	0.237	0.218	0.258	0.185
Observed HUE	0.050	0.109	0.207	0.191	0.178	0.134
Estimated catch	315(5.9)	2672(50.0)	559(10.5)	454(8.5)	1346(25.2)	5346(100.0)
Estimated harvest	137(3.6)	1865(48.6)	500(13.0)	416(10.8)	917(23.9)	3835(100.0)

Table 4.21 Percent occurence of and observed CUE associated with different lake trout angling method and bait-type combinations used during the February 4-19, 1984 lake trout open season on Charleston Lake.
An asterisk denotes an impossible combination.
Blank spaces indicate no recorded effort.
CUE values associated with low percent occurence will tend to be less precise.

Bait Type[1]	Fishing Method[2]									
	Jig 1		Jig 2		Still 1		Still 2		Combination 2	
	Occ.	CUE	Occ.	CUE	Occ.	CUE	Occ.	CUE	Occ.	CUE
Herring										
Artificial	42.9	0.247								
Natural					2.0	0.390	7.1	0.000		
Art./Nat. Combination	28.4	0.220			1.0	0.000				
Herring and Artificial	*				*				1.0	0.774
Herring and Natural	*				*					
Artificial and Natural	*		0.5	0.133	*				8.8	0.136
Herring and Combination	*				*				2.6	0.150
Artificial and Combination	*				*					
Natural and Combination	*				*				13.8	0.122

[1] Definition of bait-types: Herring=herring bait, angler fishing 1 or 2 lines; Artificial=artificial bait, 1 or 2 lines; Natural= natural bait, 1 or 2 lines; Art./Nat. Combination=combination of artificial and natural bait on same line, 1 or 2 lines; Herring and Artificial=1 line herring, 1 line artificial bait; Herring and Natural=1 line herring, 1 line natural bait; Artificial and Natural=1 line artificial, 1 line natural bait; Herring and Combination=1 line herring, 1 line artificial/natural bait; Artificial and Combination=1 line artificial, 1 line artificial/natural bait; Natural and Combination=1 line natural, 1 line artificial/natural bait.

[2] Definition of fishing methods: Jig 1=angler jigging with 1 line, no second line; Jig 2=angler jigging with 2 lines; Still 1=angler still fishing with 1 line, no second line; Still 2=angler still fishing with 2 lines; Combination 2=angler still fishing with 1 line, jigging with second.

Table 4.22 Return of stocked lake trout from the Charleston Lake 1984 winter sport fishery.
Values in parentheses denotes percent of number stocked.

Year Class	Number Stocked	Stocking Rate (#/ha)	Estimated Winter Harvest
1974	20000	7.95	105 (0.5)
1975	20000	7.95	0
1976	20000	7.95	0
1977	15000	5.96	0
1978	20000	7.95	549 (2.8)
1979	20000	7.95	1072 (5.4)
1980	23000	9.14	915 (4.0)
Total	138000		2615 (1.9)

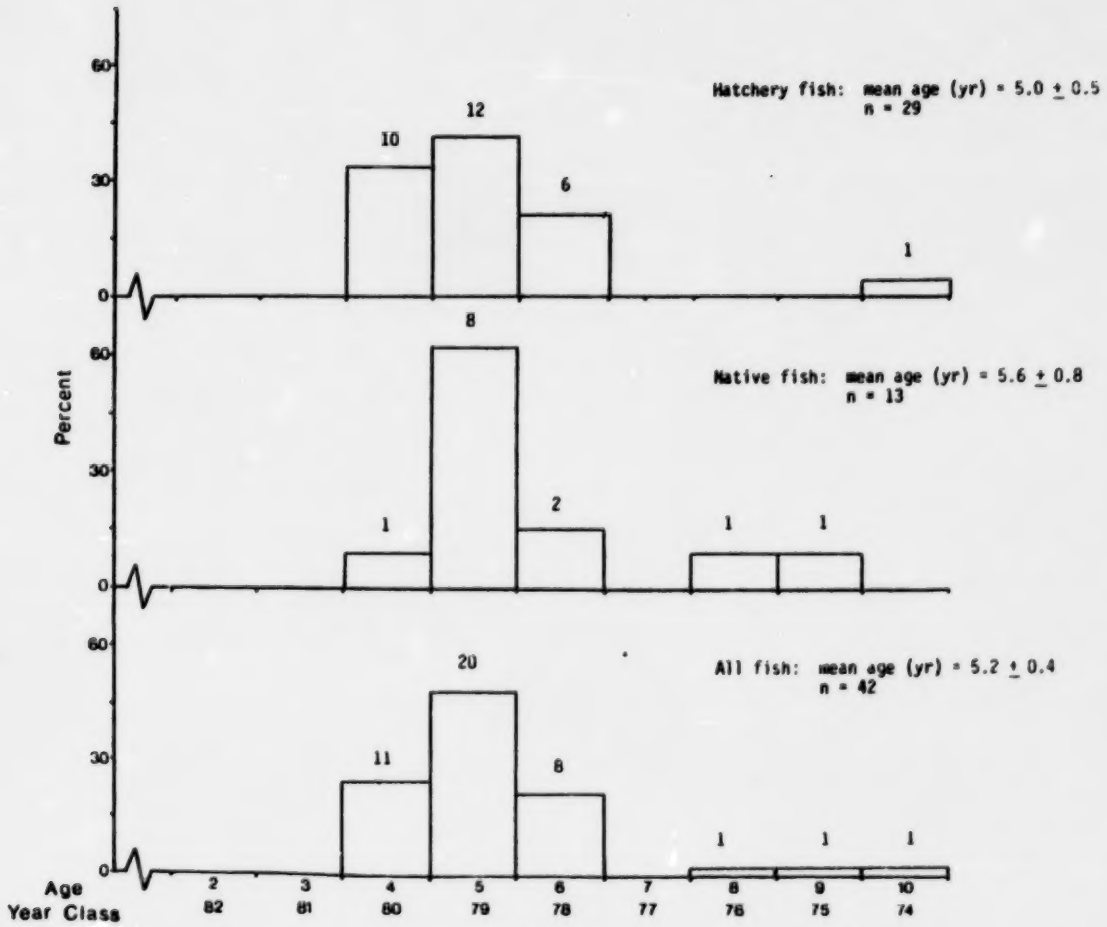

Figure 4.10 Age distribution of lake trout sampled during the winter 1984 sport fishery on Charleston Lake. Numbers over each bar indicate actual count frequencies.

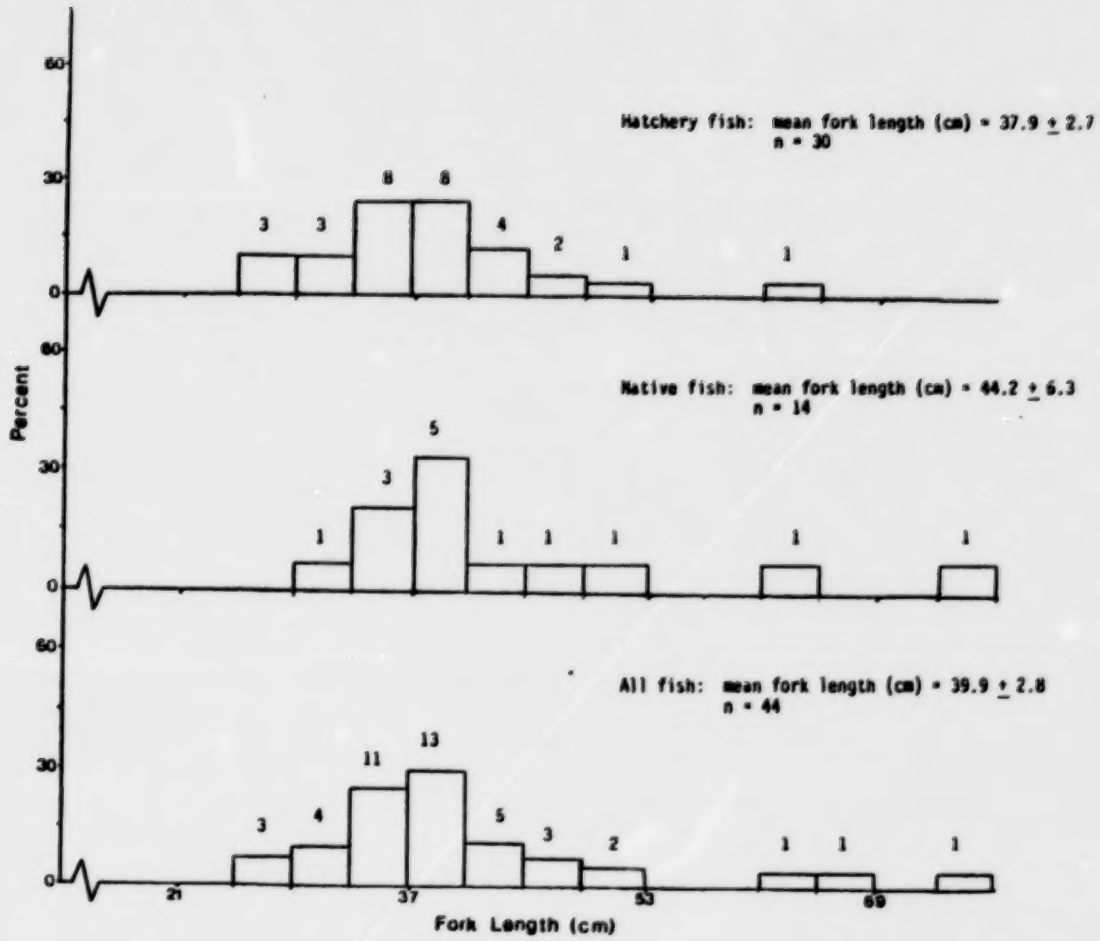

Figure 4.11 Fork length distributions of lake trout sampled during the winter 1984 sport fishery on Charleston Lake.
Numbers over each bar indicate actual count frequencies.

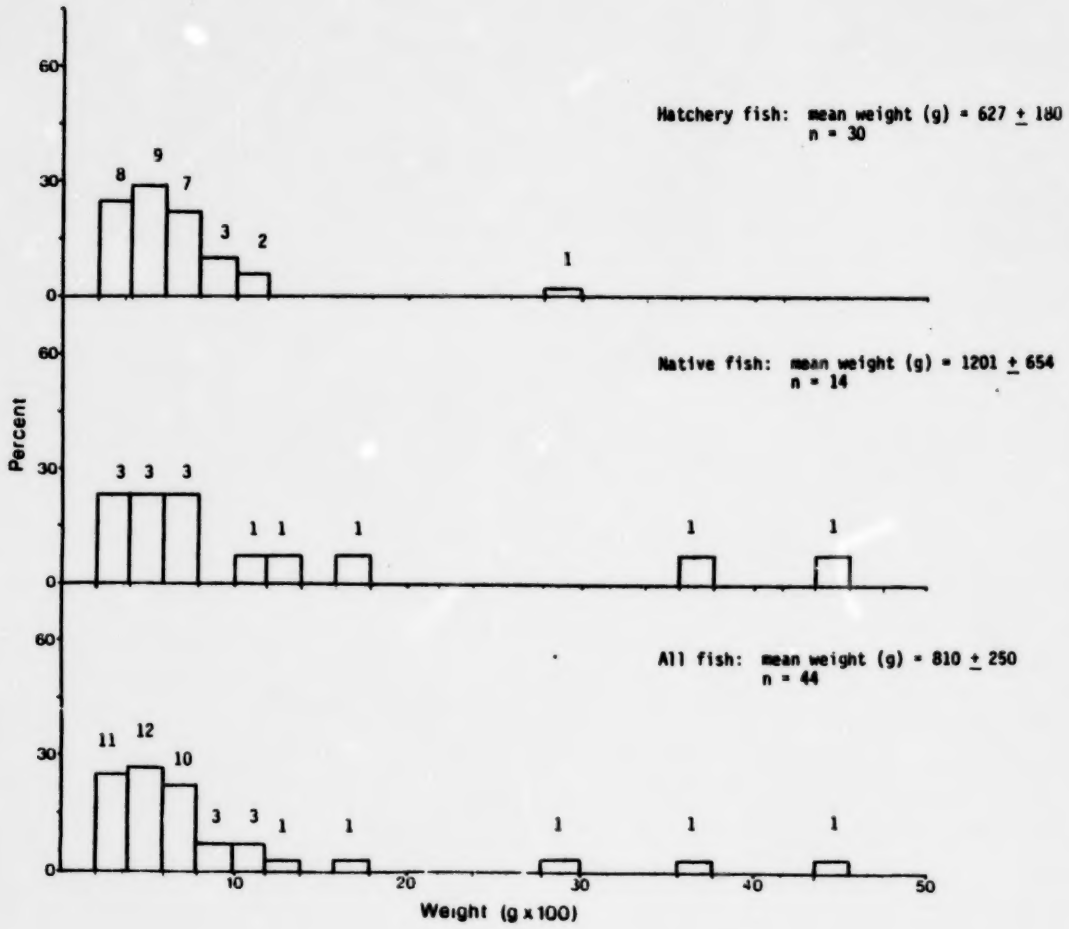

Figure 4.12 Weight distributions of lake trout sampled during the winter 1984 sport fishery on Charleston Lake. Numbers over each bar indicate actual count frequencies.

4.5 DEVIL LAKE

4.5.1 Winter creel census, 1984

One hundred and sixty-four anglers were interviewed during seven sampling days.

Distribution of angling effort- An estimated 25095 rod-hours (23.6 rod-hrs/ha) were exerted during the 16-day open season (Table 4.23). Area 1 received 50.3% of this effort (Table 4.24).

Weekend anglers accounted for 62.6% of the overall angling effort. The average weekend-day effort was 2.8 times greater than the average weekday effort. During weekdays, morning effort was 2.8 times afternoon effort. Weekend-days were not stratified by time period.

All angler effort was directed towards lake trout.

Total catch and harvest- Lake trout and lake herring were observed during the census. Lake trout made up 95% of the total number of fish caught (Table 4.23).

The lake trout fishery- Lake trout anglers were most successful in Area 1 and least successful in Area 3 (Table 4.25). The observed CUE for all the areas combined was 0.056 trout/rod-hr. The observed HUE was 0.042 (Table 4.25). Overall an estimated 1638 lake trout were caught, of which 1253 were harvested (Table 4.23).

The lake trout harvest consisted mostly of Age IV, VI and VII fish. Ten percent of all sampled fish were of hatchery origin. Age, length, and weight frequency distributions are depicted in Figs. 4.13- 4.15 and mean values with 95% confidence limits are compared below.

Sample	n	Age (yr)	Total Length (cm)	Fork Length (cm)	Weight (g)
hatchery fish	5	5.4 +/- 2.6	42.2 +/- 23.7	38.8 +/-21.5	1108 +/-1736
native fish	47	5.8 +/- 0.4	45.8 +/- 3.6	41.8 +/-3.5	1015 +/- 248
all fish	52	5.7 +/- 0.4	45.5 +/- 3.6	41.5 +/-3.3	1024 +/- 248

The total estimated lake trout yield for the 1984 winter fishery was 1.21 +/- 0.44 kg/ha. The estimated yield of native lake trout was 1.08 kg/ha.

Fishing methods- The mean number of rods/angler was 1.96. The most common method was to fish with two lines using a herring bait on one and jig with an artificial/natural combination bait on the other (Table 4.26). The age, fork length

and weight of the fish caught on herring bait were all significantly ($p<0.05$) larger than for fish caught on other baits (Student's 't' test- age $t=2.235$, d.f.=50; fork length $t=2.350$, d.f.=50; weight $t=2.396$, d.f.=50)(Table 4.27).

User group information- Eighty-two percent of anglers interviewed were local residents of Ontario (living within 50 km of Chaffey's Locks), 17% were non-local Ontario residents, and 1% were citizens of the U.S.A. Ninety-six percent of the anglers interviewed were day trippers, 2% of the anglers stayed at non-commercial lodging and 1% paid for their accomodation.

4.5.2 Status of the fishery

Yield- The estimated total yield of naturally produced lake trout for the winter fishery was 1.09 kg/ha. This is 31% of the potential annual yield for all species (3.48 kg/ha/yr) and 124% the recommended maximum yield for the native lake trout (0.87 kg/ha/yr).

Biological characteristics of the lake trout harvest- Lake trout in Devil Lake apparently mature after reaching Age V (RLFAU 1981a,b). Since lake trout are fall spawners, trout taken during the winter open season at Age V or less will not have spawned for the first time. Therefore, an estimated 38% of the trout taken had never spawned (assuming that all fish spawn) (Fig. 4.15).

Approximately 10% of the fish harvested were of hatchery origin. The return of hatchery origin lake trout for the range of year classes represented in the 1984 winter harvest was 0.6% (Table 4.28).

Table 4.23 Summary of catch, harvest and effort data from the creel census conducted on Devil Lake during the February 4-19, 1984 lake trout open season. Values in parentheses are standard errors.

ALL ANGLERS

Species	# Anglers	OBSERVED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)	ESTIMATED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)
Lake trout	164	81	61	1435	0.056	0.043	1638 (301)	1253 (197)	25095 (2494)	0.065	0.050
Lake herring	164	4	4	1435	0.002	0.002	144 (129)	144 (129)	25095 (2494)	0.005	0.005

SPECIES SPECIFIC ANGLERS

Species	# Anglers	OBSERVED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)	ESTIMATED Catch (#)	Harvest (#)	Effort (rod-hr)	CUE (#/rod-hr)	HUE (#/rod-hr)
Lake trout	164	81	61	1445	0.056	0.042	1638 (255)	1253 (166)	25136 (2469)	0.065	0.050

Table 4.24 Distribution of estimated angling effort (rod-hr) for all anglers by area, day-type, and time period during the February 4-19, 1984 lake trout open season on Devil Lake. Values in parentheses are percentages of the grand total.

Statum	Weekday		Weekend-day[1]	Total
	AM	PM	AM + PM	
Area 1	3315	1525	7796	12636 (50.3)
Area 2	1350	250	4172	5772 (23.0)
Area 3	2260	685	3742	6687 (26.6)
Entire Lake	6925 (27.6)	2460 (9.8)	15710 (62.6)	25095 (100.0)
Entire Lake (AM + PM)	9385 (37.4)		15710 (62.6)	
Mean Daily Effort[2]	938.5		2618.3	

[1] Weekend-days were not stratified by time period.

[2] The season included 10 weekdays and 6 weekend-days.

Table 4.25 Observed CUE and HUE for lake trout anglers and estimated lake trout catch and harvest for all anglers by area during the February 4-19, 1984 lake trout open season on Devil Lake. Values in parentheses are percentages of the total catch or harvest.

Parameter	Area			Entire Lake
	1	2	3	
Observed CUE	0.065	0.055	0.034	0.056
Observed HUE	0.048	0.039	0.032	0.043
Estimated catch	878 (53.6)	458 (28.0)	301 (18.4)	1637 (100.0)
Estimated harvest	677 (54.1)	304 (24.3)	271 (21.6)	1252 (100.0)

Table 4.26 Percent occurence of and observed CUE associated with different lake trout angling method and bait-type combinations used during the February 4-19, 1984 lake trout open season on Devil Lake.
An asterisk denotes an impossible combination.
Blank spaces indicate no recorded effort.
CUE values associated with low percent occurence will tend to be less precise.

Bait Type[1]	Fishing Method[2]									
	Jig 1		Jig 2		Still 1		Still 2		Combination 2	
	Occ.	CUE	Occ.	CUE	Occ.	CUE	Occ.	CUE	Occ.	CUE
Herring							22.7	0.014	1.8	0.00
Artificial	1.2	0.364							0.6	0.211
Natural	0.6	0.667					6.8	0.091	1.2	0.545
Art./Nat. Combination	3.1	0.100					1.2	0.000	1.2	0.111
Herring and Artificial		*				*			6.8	0.086
Herring and Natural		*				*	3.7	0.077	1.8	0.059
Artificial and Natural		*				*			1.2	0.000
Herring and Combination		*				*	3.1	0.000	31.3	0.052
Artificial and Combination		*				*			1.2	0.085
Natural and Combination		*				*			10.4	0.082

[1] Definition of bait-types: Herring=herring bait, angler fishing 1 or 2 lines; Artificial=artificial bait, 1 or 2 lines; Natural= natural bait, 1 or 2 lines; Art./Nat. Combination=combination of artificial and natural bait on same line, 1 or 2 lines; Herring and Artificial=1 line herring, 1 line artificial bait; Herring and Natural=1 line herring, 1 line natural bait; Artificial and Natural=1 line artificial, 1 line natural bait; Herring and Combination=1 line herring, 1 line artificial/natural bait; Artificial and Combination=1 line artificial, 1 line artificial/natural bait; Natural and Combination=1 line natural, 1 line artificial/natural bait.

[2] Definition of fishing methods: Jig 1=angler jigging with 1 line, no second line; Jig 2=angler jigging with 2 lines; Still 1=angler still fishing with 1 line, no second line; Still 2=angler still fishing with 2 lines; Combination 2=angler still fishing with 1 line, jigging with second.

Table 4.27 Comparison of morphological data on lake trout caught on herring bait and other baits in Devil Lake, Febuary 4-19, 1984. Mean age, fork length and weight are given with 95% confidence limit.

Bait Type	n	Age (yrs)	Fork Length (cm)	Weight (g)
Herring	21	6.0 +/- 0.6	44.5 +/- 4.1	1206 +/- 327
Other	31	5.3 +/- 0.7	37.2 +/- 5.5	755 +/- 407

Table 4.28 Return of stocked lake trout from the Devil Lake 1984 winter sport fishery.
Values in parentheses denotes percent of number stocked.

Year Class	Number Stocked	Stocking Rate (#/ha)	Estimated Winter Harvest
1976	6800	6.41	39 (0.6)
1977	6000	5.66	0
1978	4400	4.15	0
1979	3000	2.83	39 (1.3)
1980	4000	3.77	39 (1.0)
1981	3600	3.39	39 (1.0)
Total	27800		158 (0.6)

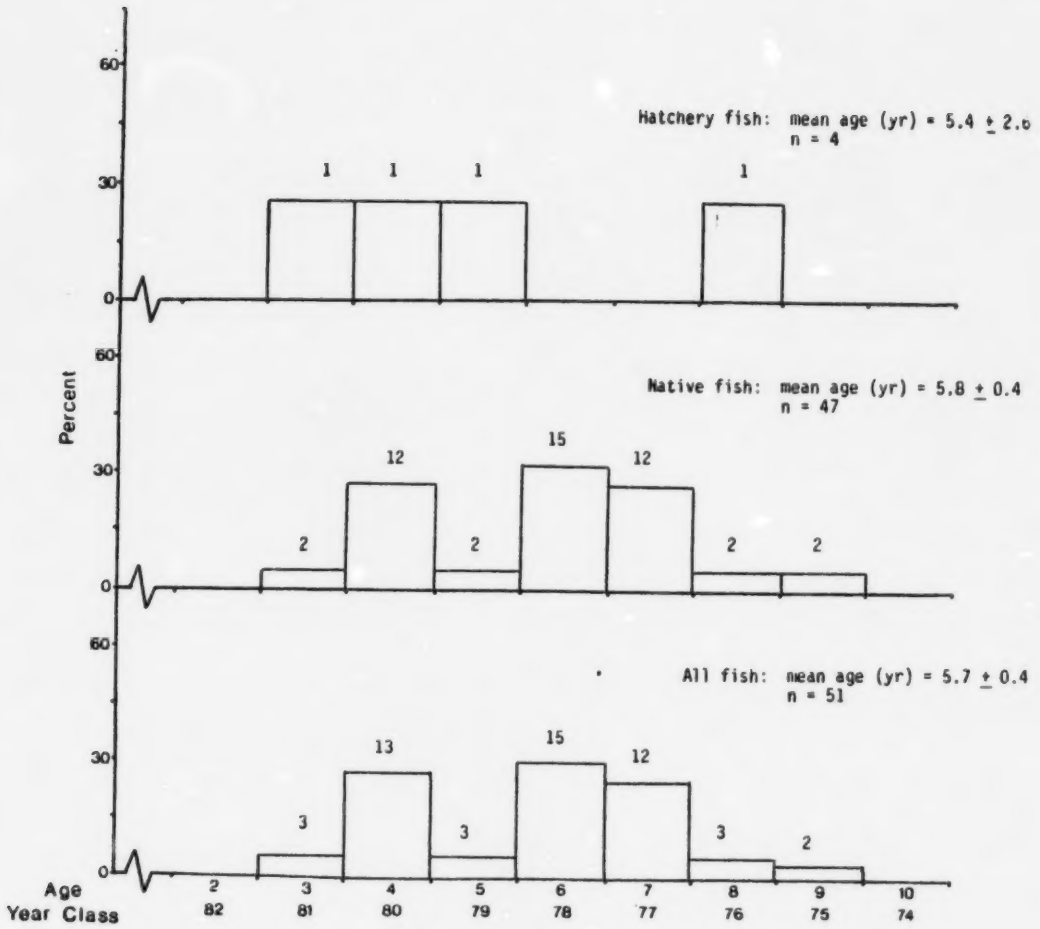

Figure 4.13 Age distributions of lake trout sampled during the winter 1984 sport fishery on Devil Lake. Numbers over each bar indicate actual count frequencies.

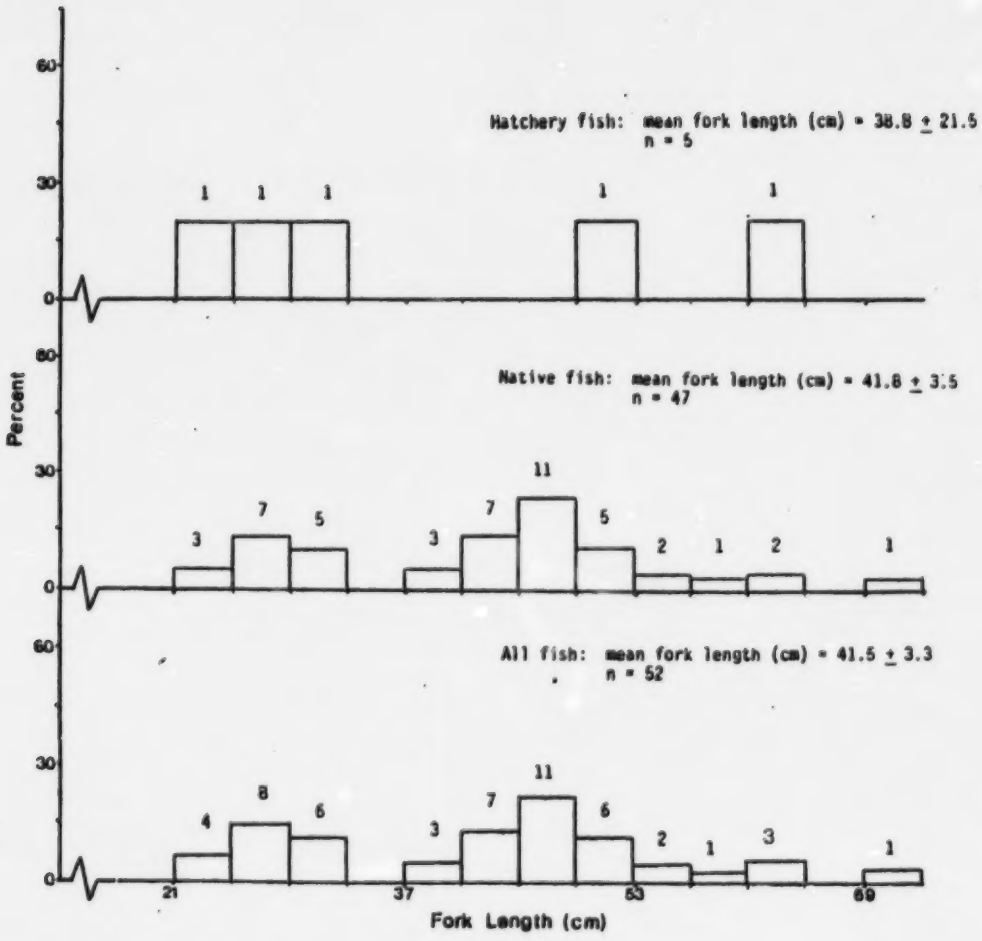

Figure 4.14 Fork length distributions of lake trout sampled during the winter 1984 sport fishery on Devil Lake.
Numbers over each bar indicate actual count frequencies.

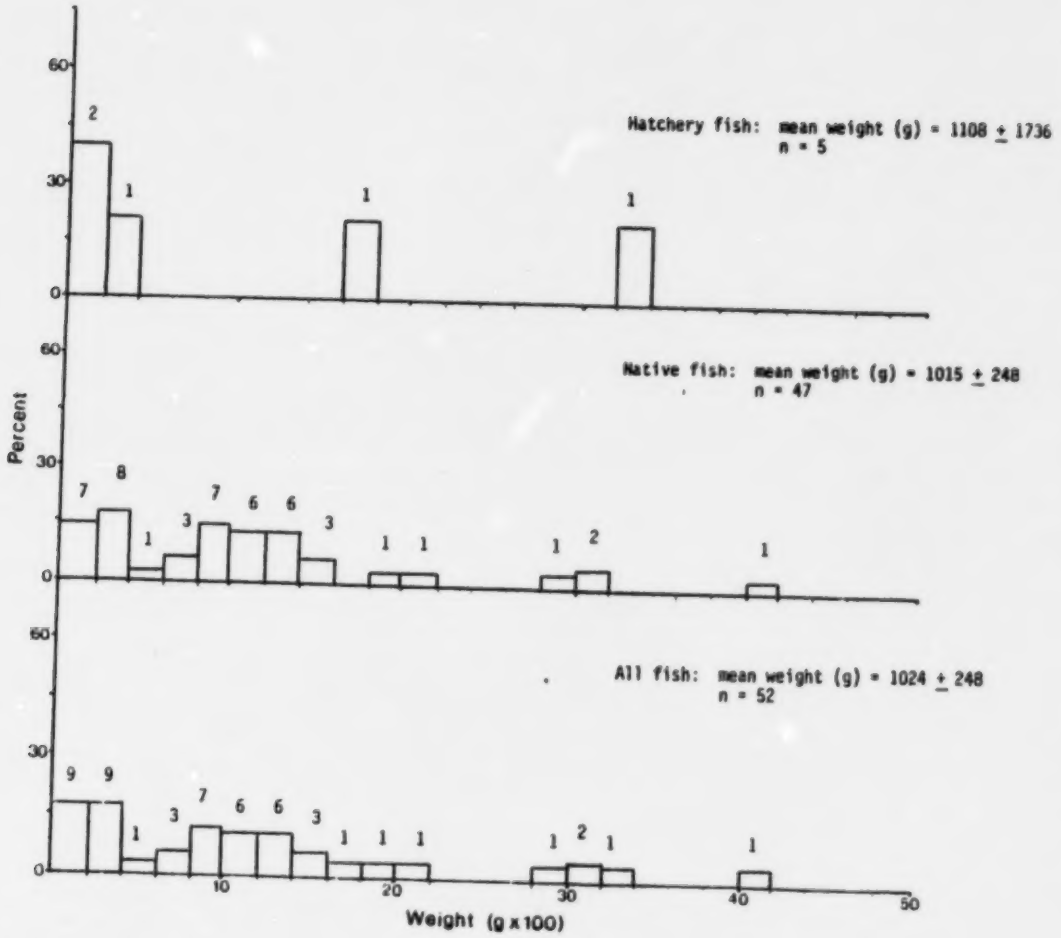

Figure 4.15 Weight distributions of lake trout sampled during the winter 1984 sport fishery on Devil Lake. Numbers over each bar indicate actual count. frequencies.

5. MANAGEMENT IMPLICATIONS

5.1 LEVEL OF EXPLOITATION

5.1.5 Indices of overexploitation

Overexploitation is prominent among the reasons cited for the erosion of fishery resources and the loss of recreation and business opportunites in Ontario (Loftus 1976). Members of the SPOF Working Group #15 (MNR 1983) offered the following definition for overexploitation:

> A fishery resource is being overexploited if, because of fishing, yields no longer can be maintained at or near peak potential, or there is good reason to believe that the resource is predisposed to collapse or displacement.

It has been proposed that the level of stress from exploitation can be ascertained from the changes in the relationships between angler effort and fish yield and abundance (MNR 1983) as described in Table 5.1. There is no single biological measurement, short of collapse of the population that stands alone as an adequate index of overexploitation. Members of the SPOF Working Group #15 (MNR 1983) described several indices which, taken together, can provide a reasonable picture of the level of exploitation in a fishery, ie. relative yield indices, total mortality, Abrosov Index, length-at-age, and trend analysis. It should be pointed out that these indices of overexploitation were described for lakes which were not heavily supported by stocking. The situation for most of our lakes is complicated by their high level of stocking. Some of these indices are described below.

Table 5.1. Relationship between yield, fishing effort and fish abundance during stages in the development of a fishery.

Yield	Fishing Effort	Abundance	Stage of Development
low	low	high	very early stage
intermediate	low	high	early stage
intermediate	intermediate	intermediate	early intermediate
high	high	intermediate	late intermediate
high	high	highly variable	heavily stressed
intermediate	high	low	recently overstressed
low	low	low	late stage of overexploitation

Relative Yield Indices (RYI and RORY) - MNR (1982) stressed that the exploitation levels they developed were of an interim nature and discussed several factors which may affect their present interpretation. These include: stocking, energy input and utilization, habitat destruction, method of harvesting, alterations in community structure and lake size. Stocking, in particular, warrants further discussion at this time.

The effects of stocking on relative yield is poorly understood. None of the fisheries in Ryder's (1965) original data set were supported by stocking, whereas our five study lakes have been stocked with lake trout for years. It is unclear what influence stocking has on relative yield indices. It is possible that for a given angling effort, the weight of fish harvested from a stocked fishery is more closely related to the weight of fish stocked than to the level of surplus natural production associated with the MEI (MNR 1983). Alternatively, if juveniles are stocked prior to recruitment, density-dependent factors, related to the MEI, will reduce the total population of potential recruits to a level compatible with the inherent carrying capacity of each lake. In this report relative yield indices are based on the harvest of native fish only.

In addition, the inherent confidence limits associated with observed and potential yield calculations make interpretation even more difficult. A rule of thumb stated in the report of SPOF working group number twelve (MNR 1982) is that the true value of the potential yield may be from 0.33 to 3 times the estimated value. Confidence limits for observed yield calculated in this report suggest that the true values are between 0.5 and 1.5 times the estimated value.

Nonetheless , MNR (1983) recommends that for a margin of safety in managing a multispecies fishery, the total yield of all species should be less than 100% of the potential yield, ie. the sum of estimated exploitation levels is less than 100% or the RYI is less than one. It is important to note however, that although a RYI or RORY value of greater than one is suggestive of overexploitation, a value less than one is not necessarily "safe". A value less than one could indicate that a fishery is on the verge of collapse as a result of prior overexploitation.

Total mortality- Total annual mortality rates of lake trout populations in Ontario commonly range from 50% to 70% (Martin and Olver 1980). Tentatively, a total mortality rate greater than 50% may be indicative of overexploitation (MNR 1982). We have calculated total mortality rates for the lake trout populations using catch curves (Ricker 1975).

Four years data has shown that these mortality estimates are usually very imprecise due to small sample size and few age classes. There are also questions concerning the representativeness of a catch curve combining age structures of native and hatchery fish.

Abrosov Index- This index is calculated by subtracting the age at onset of sexual maturity from the mean age of the harvest. Values less than one usually suggest the possibility of

reproductive failure due to the overexploitation of mature individuals.

We have modified the index slightly by taking the difference between mean age and age at first spawning. Since evidence to date suggests that lake trout in Rideau area lakes mature after reaching Age V (RLFAU 1981a, b), we have assumed that the age at first spawning is 5.5 years.

Growth- Intensive exploitation often results in accelerated growth, since fish that avoid capture are partially released from competition for food. This has been termed "growth compensation".

Standard growth curves for several Ontario sport fish species have been produced (MNR 1983), and fork length-at-age for a given population can be compared to the appropriate standard growth curve.

The standard growth curve for lake trout has been reproduced here (Figure 5.1). Mean values of fork length-at-age for the lake trout populations in our five study lakes have been compared to the growth standard when we had a good sample (ie. 95% CL < 10% of mean). Normal variations in growth indices (observed FL x 100 / standard curve FL) are assumed to be no greater than five percent (MNR 1983).

Trend analysis- The trend-through-time of these indices, as well as trends of fishery statistics such as CUE, catch and effort will prove invaluable for assessing changes in the level of exploitation.

5.1.2 Assessment of individual lake trout populations

In the following assessments, we have assumed that a general sequence of events takes place when a fish population is exploited (Table 5.1). In the "very early stage" of development effort initially expands, yield increases, while total mortality rate, growth rate, and mean age remain relatively constant. As effort expands further and the population enters the "early stage" of development yield will continue to increase. In the intermediate stages of development effort and yield will continue to increase while CUE and mean age decrease, and total mortality rate and growth rate increase. In the "heavily stressed" stage effort and yield remain high however CUE becomes highly variable. In the "recently overstressed" stage fishing effort remains high while yield starts to decline. Finally, in the "late stage of overexploitation", yield, CUE and mean age have all decreased substantially, while total mortality rate and growth remain high.

The indices of overexploitation alone do not lead to a clear cut interpretation for any of the five study lakes. Trend-through time analysis will provide a more conclusive picture. Throughout the following discussion, it should be kept in mind that only a winter creel was carried out in 1984. Trend interpretation of results for the 1984 winter fishery is especially difficult for Big Rideau, Charleston and Devil Lakes where the summer

fishery is more important than the winter fishery.

Big Clear Lake- From 1981 to 1983, the lake trout sport fishery in Big Clear Lake experienced a gradual decline in yield, CUE, and Abrosov Index together with an increase in the proportion of stocked fish in the harvest. These trends suggested that exploitation stresses were increasing and that the fishery was in the intermediate stage of development (Table 5.1, Barnes et al 1984). However, in the 1984 winter fishery, increases in CUE and native lake trout yield, and a decrease in the proportion of stocked fish, all seem to indicate that the native lake trout population is recovering from this period of poor performance. Nevertheless, in 1984 an increase in angler effort and continued decline in the Abrosov Index suggest that stress levels are still increasing. Highly variable fish abundance is characteristic of a population in the heavily stressed stage of development and it is likely that the apparent recovery of the lake trout population will be short lived.

The winter lake trout fishery on Big Clear is relatively far more important than the summer. In both 1981 and 1983, the winter fishery accounted for approximately 85% of the lake trout yield and 96% of the effort. Angling effort during the 1984 winter fishery increased by 53% (with respect to the 1983 value), returning to 1981, 1982 levels.

The yield of all lake trout during the 1984 winter fishery was 2.29 kg/ha, while the yield of native fish was 1.59 kg/ha. This represents increases of 79% and 109% respectively over 1983 values.

CUE also increased by 51% over 1983, returning to 1981 levels after a two year decline.

The proportion of stocked lake trout in the harvest decreased substantially to 44.1%.

Mortality and growth rates for Big Clear Lake's lake trout population have never suggested overexploitation. In 1984, mortality rate remained within recommended levels; growth continued to approximate the standard growth curve. On-the-other-hand, the Abrosov Index has declined steadily over the past four years (Table 5.2 - 5.5).

Big Rideau Lake- Trends in yield and CUE seem to indicate that the lake trout fishery in Big Rideau Lake is relatively stable at present stocking rates and is in one of the intermediate stages of development. However, the Abrosov Index, mortality rate, growth rates, and the percentage of stocked fish in the harvest all suggest prior overexploitation.

The winter fishery in Big Rideau Lake generally makes up 20% of the annual yield and 34% of the annual effort. Effort in the 1984 winter fishery increased 34% to the highest level in the past four years.

Yield of all lake trout was 0.36 kg/ha, while yield of native fish was 0.17 kg/ha. This represents a decrease of 28%

and 32% with respect to the 1983 winter values. The RORY value was 0.17.

CUE has remained relatively stable over the last three years after a 1981 high. While the yield of lake trout decreased with respect to the 1983 value, the catch increased by 52%. This incongruous occurence can be attributed to two factors: 1) The percentage of the lake trout catch which are kept has declined from 81% in 1983 to 67% in 1984; 2) The mean weight of lake trout sampled in 1983 was 1.6 kg, while in 1984, it was 0.9 kg.

Mortality rate in the 1984 winter fishery (0.53) was slightly above recommended levels.

The Abrosov Index, growth rates, and the percentage of hatchery fish in the harvest have only experienced minor fluctuations over the last four years. In general, the Abrosov Index has been consistently low (-0.6), while both growth and the percentage of hatchery origin fish have remained high (120%-130% of growth standard and 65%-69% stocked lake trout).

Big Salmon Lake- The decline in mortality and the increases in yield and CUE suggest that the lake trout population in Big Salmon Lake is recovering from recent overexploitation. Big Salmon Lake's lake trout fishery is apparently in the intermediate to heavily stressed stage of development. However it is difficult to assess this population without a better understanding of the summer fishery.

The relative importance of the winter fishery in Big Salmon Lake seems to be increasing with the implementation of the motor ban in Frontenac Park. In 1981 the winter fishery represented 56% of the annual effort and 59% of the annual yield. In 1983 the winter fishery had increased to 86% of the annual effort and 67% of the annual yield. The angling effort in the 1984 winter fishery decreased 16% relative to 1983, but still remained the second highest value in four years.

The yield of all lake trout from the 1984 winter fishery was 2.31 kg/ha while the native yield was 1.18 kg/ha. This represents a 59% and 93% increase over the 1983 values respectively. The corresponding RORY value was 1.72.

The CUE increased by 102% with respect to the 1983 winter value. This increase represents the first upward fluctuation after a three year decline. The four years of winter data seem to indicate that CUE values follow the yield of native lake trout.

Mortality has decreased to 0.25 from the 1983 winter value of 0.60. While there were no trends apparent in the Abrosov Index, mean growth indices have fallen below the standard growth curve over the last four years.

The percentage of stocked lake trout in the harvest declined for the first time since 1984.

Charleston Lake- Barnes et al. (1984) suggested that anglers were "fishing up" the lake trout population. Fishery statistics from the 1984 winter creel support that interpretation; effort continued to increase, CUE and yield of native lake trout declined and the proportion of stocked fish in the harvest increased.

The winter fishery on Charleston Lake generally makes up 28% of the annual effort and 22% of the annual yield. Winter angler effort remained high in 1984, increasing 8% over the 1983 value.

The yield of all lake trout for the 1984 winter fishing season was 1.23 kg/ha, while the yield of native fish was 0.58 kg/ha. Relative to the 1983 values this represents a decline of 27% and 48% respectively.

The lowest CUE value in four years was observed in 1984. This represented a 30% decrease with respect to the 1983 value.

The mean growth index for 1984 was 115%, continuing the trend for growth rates exceeding the provincial average.

The proportion of stocked fish in the harvest has continued to increase over the last three years.

Although the Abrosov Index has increased slightly in recent years, values are still negative.

Devil Lake- Trends in yield, effort, and growth suggest that the fishery is in the early intermediate stage of development.

The winter fishery generally accounts for 68% of the annual angling effort and 28% of the annual yield. Effort in the 1984 winter season decreased 22% relative to the 1983 season.

Yield of all lake trout was 1.21 kg/ha while native yield was 1.08 kg/ha. This represented a decrease of 17% and 19% with respect to the 1983 estimates. The RORY value for the winter season alone continues to be high at 1.24.

Lake trout abundance, as indicated by CUE, appears to be increasing. The 1984 winter CUE increased by 56% after a three year decline.

While the Abrosov Index showed a slight decline from the 1983 level, the mean growth index has continued to decline from its previously high levels (though it still exceeds the provincial average).

The proportion of stocked fish in the harvest continues to be at a low level.

5.2 ASSESSMENT OF STOCKING PROGRAMS

During the 1984 winter lake trout season, the percentage return of hatchery origin lake trout for all year classes represented in the harvest ranged from 0.56 to 6.31 (Table 5.4). These values are comparable to previous years' estimates for these lakes and also similar to the 1.14% return for lake trout stocked as yearlings in a Maine lake (Anderson 1962).

Stocking success over the last four years was quite variable between years and seasons. No general relationship between stocking rate and year class strength is evident. The return of stocked fish appears to be consistently low in Devil Lake and consistently high in Big Salmon Lake.

5.3 COMPARISON OF FISHING METHODS

Since 1981, there has been a steady increase on Big Clear, Big Salmon, and Devil Lakes in the proportion of lake trout anglers using herring as bait. (In Big Rideau and Charleston Lakes the use of herring as bait has never been popular and the number of trout caught using this method is very small.)

In general, our catch sampling data has shown that the mean age, mean fork length and mean weight of "herring caught" lake trout was larger than for trout caught on other baits (Section 4 this report; Barnes et al. 1984). However, statistical comparisons were complicated by small sample sizes. We combined fork length data from the 1981 to 1984 winter fisheries for each of Big Clear, Big Salmon and Devil Lakes and tested for differences using analysis of variance (2-way ANOVA on log 10 transformed data- using bait type and year as the two factors). The tests showed that in Big Clear ($F=33.130$, $df=1,197$, $p<0.001$), and Devil Lakes ($F=30.763$, $df=1,183$, $p<0.001$), trout caught on herring bait had significantly larger fork lengths than those caught on other baits. Also, within each lake there was a significant variation in the fork length of trout caught in different years. In Big Salmon Lake the differences in the fork lengths of lake trout caught on herring bait and those of fish caught on other baits were not significant ($F=0.650$, $df=1,167$, $p>0.05$).

Figure 5.1 Mean length at scale age, growth rate, and "scope for linear growth" for lake trout. Prepared from 42 sets of Ontario data. Mean fork length (cm) at assigned scale age (yr) is plotted with the number of contributing data sets indicated below. The 95% confidence limits are illustrated for ages containing six or more data sets and are joined, delineating the 95% confidence interval illustrated by the dark shaded band. The smallest and largest data set for each age are illustrated by crossbars on the vertical range lines. Lines joining these crossbars (and light shaded bands) delineate the population "scope for linear growth" for the species. The mean fork length values for each age are provided. The von Bertalanffy growth equation for the mean data is given and the curve is illustrated over the range of ages used in the calculation (ages 3 to 14). The mean ω (8.08) for Ontario lake trout is given where $\omega = k.L_\infty$ and corresponds to the growth rate near t_0 (Gallucci and Quinn 1979), and was calculated by using the von Bertalanffy growth parameter k (0.056) and the asymptotic length parameter L_∞ (145.25). (taken from MNR 1983)

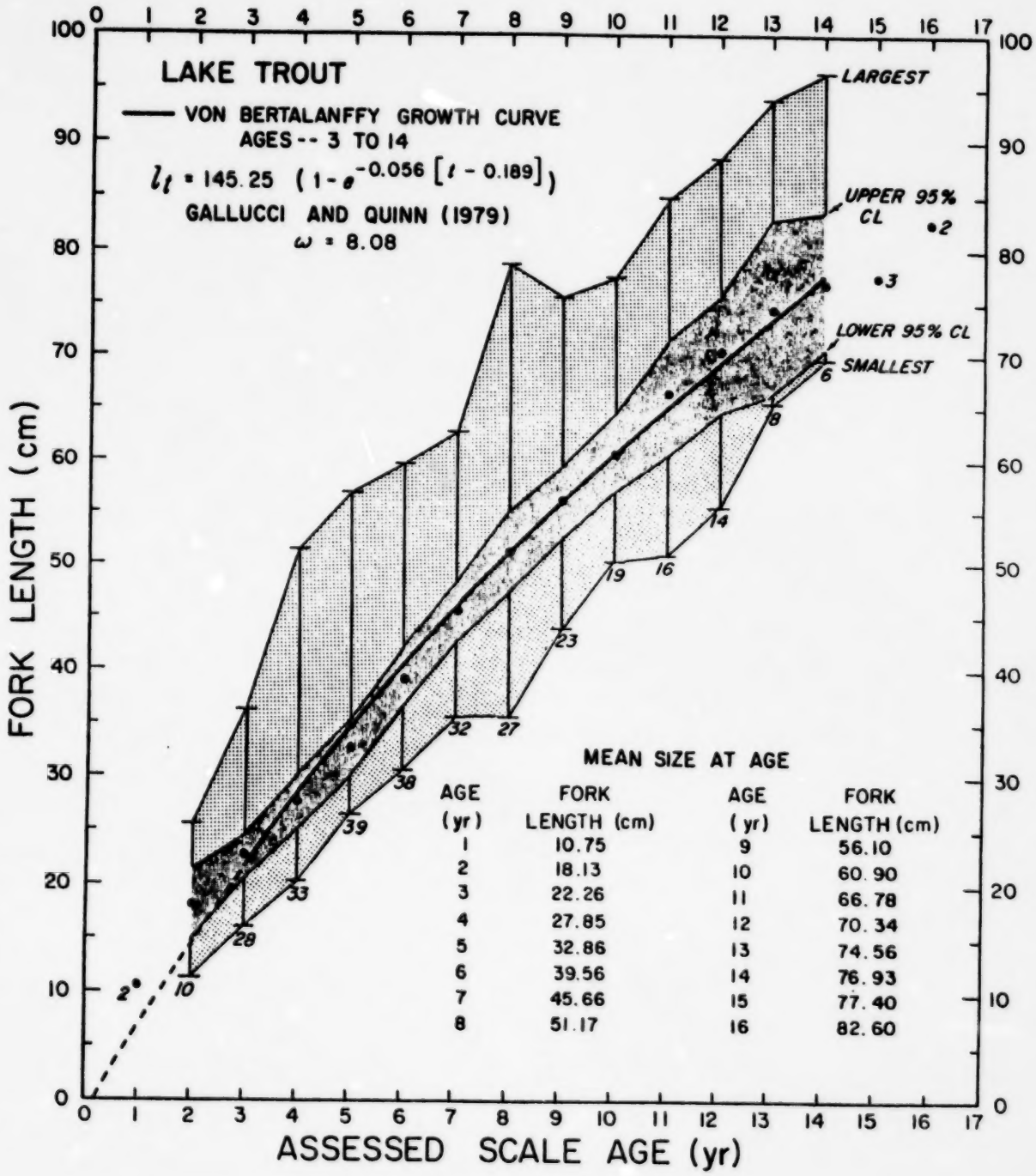
LAKE TROUT
VON BERTALANFFY GROWTH CURVE
AGES -- 3 TO 14
$l_t = 145.25\ (1 - e^{-0.056\,[t\,-\,0.189]})$
GALLUCCI AND QUINN (1979)
$\omega = 8.08$
LARGEST
UPPER 95% CL
LOWER 95% CL
SMALLEST
FORK LENGTH (cm)
ASSESSED SCALE AGE (yr)
MEAN SIZE AT AGE
AGE (yr) | FORK LENGTH (cm) | AGE (yr) | FORK LENGTH (cm)
1 | 10.75 | 9 | 56.10
2 | 18.13 | 10 | 60.90
3 | 22.26 | 11 | 66.78
4 | 27.85 | 12 | 70.34
5 | 32.86 | 13 | 74.56
6 | 39.56 | 14 | 76.93
7 | 45.66 | 15 | 77.40
8 | 51.17 | 16 | 82.60

Table 5.2 Trends in indices of overexploitation, and estimates of catch and effort for lake trout populations of Big Clear, Big Rideau, Big Salmon, Charleston and Devil Lakes, 1981-1984.
Values in parentheses are the recommended maximum lake trout yields for each lake (kg/ha/yr).
'ne' denotes values not estimated.
Blanks denote not sampled.

Lake	Year	RORY			Total Mortality Rate		Abrosov Index		Mean Growth Index	CUE		Catch		Effort	
		T	W	S	W	S	W	S	W	W	S	W	S	W	S
Big Clear	81	3.70	3.21	0.49	0.47	ne	0.4	1.5	96	0.119	0.118	751	58	6322	535
(0.53)	82		3.42		0.24		0.4		-	0.085		810		8896	
	83	1.53	1.43	0.09	ne	ne	0.0	0.3	101	0.084	0.104	442	12	4664	220
	84		3.00		0.41		-0.5		98	0.127		1097		7130	
Big Rideau	81	0.97	0.17	0.81	ne	ne	-0.7	-0.7	133	0.187	0.185	3359	8069	26500	39989
(1.01)	82		0.17		0.37		-0.6		133	0.097		1832		18989	
	83	1.05	0.25	0.80	ne	0.60	0.3	-0.6	127	0.108	0.231	2343	9717	22123	39235
	84		0.17		0.53		-0.6		121	0.102		3567		26957	
Big Salmon	81	5.72	3.29	2.43	0.50		-0.5	ne	118	0.151	0.096	658	381	4454	3175
(0.69)	82		0.80		0.40		0.7		98	0.097		265		2872	
	83	1.71	0.88	0.83	0.60		1.1	ne	88	0.062	0.103	342	84	5982	1018
	84		1.72		0.25		0.4		92	0.125		665		5010	
Charleston	81	2.44	0.46	1.98	ne	0.65	-0.7	-0.7	116	0.240	0.130	3869	7474	16485	46322
(0.89)	82		0.67		0.62		-0.8		126	0.200		3101		11531	
	83	4.53	1.25	3.28	0.45	0.52	-0.3	-0.4	120	0.257	0.140	8360	14496	25417	59062
	84		0.65		ne		-0.3		115	0.181		5348		27351	
Devil	81	3.86	0.86	3.00	0.63	0.47	-0.9	0.1	126	0.046	0.151	1453	2496	29022	12256
(0.87)	82		0.72		0.28		0.4		132	0.041		886		18778	
	83	5.09	1.54	3.55	0.58	0.61	0.4	0.8	110	0.036	0.147	1533	2631	32199	16485
	84		1.24		0.52		0.2		108	0.056		1638		25095	

RORY = estimated species yield/recommended species yield.

Seasonal totals : T= Total; W= Winter; S= Summer.

Mean Growth Index= mean of growth indices for each age group (ie. observed FL x 100 / Standard Growth Curve FL)
(estimates for each age group were calculated only for cases where 95% CL < 10% of mean).

CUE: Observed CUE for anglers seeking lake trout in fish per rod-hour.

Catch: Estimated total lake trout catch by all anglers.

Effort: Estimated total effort by anglers seeking lake trout (rod-hours).

Table 5.3 Trends in yields (kg/ha) of lake trout and other target species, 1981-1983.
Ryder's potential yield in parentheses (kg/ha/yr).
Blank spaces denotes not sampled.
'ns' denotes values not estimated.

Lake	Year	RYI All Species Native	Total Yield		Lake Trout Yield						Yield of Other Target Species				
					Native			All							
			Native Fish	All Fish	W	S	T	W	S	T	Smallmouth Bass	Largemouth Bass	Northern Pike	Yellow Perch	Total
Big Clear (2.11)	81	1.28	2.71	3.27	1.70	0.26	1.96	2.09	0.43	2.53	0.61	0.14	ns	ns	0.75
	82				1.92			3.65							
	83	0.60	1.26	1.78	0.76	0.05	0.81	1.28	0.05	1.33	0.39	0.06	ns	ns	0.45
	84				1.59			2.29							
Big Rideau (4.02)	81	0.67	1.90	2.93	0.16	0.82	0.96	0.38	1.63	2.01	0.18	0.25	0.44	0.06	0.92
	82				0.17			0.34							
	83	0.49	1.98	2.94	0.25	0.81	1.06	0.53	1.50	2.03	0.18	0.44	0.21	0.09	0.92
	84				0.17			0.38							
Big Salmon (2.75)	81	1.52	4.18	5.38	2.27	1.68	3.95	3.02	2.13	5.15	ns	ns		0.09	0.23
	82				0.55			1.10							
	83	0.51	1.40	2.38	0.61	0.57	1.18	1.45	0.71	2.16	ns	ns			0.27
	84				1.18			2.31							
Charleston (3.48)	81	0.92	3.26	4.45	0.41	1.76	2.17	0.65	2.71	3.36	0.33	0.67	0.09	ns	1.09
	82				0.60			0.77							
	83	1.37	4.85	7.31	1.11	2.92	4.03	1.69	4.80	6.49	0.40	0.29	0.06	0.07	0.82
	84				0.58			1.23							
Devil (3.48)	81	0.96	3.33	4.37	0.74	2.61	3.35	0.84	2.62	3.46	0.46	0.45	ns	ns	0.91
	82				0.63			0.65							
	83	1.61	5.62	5.83	1.34	3.09	4.43	1.46	3.18	4.64	0.64	0.14	0.41	ns	1.19
	84				1.08			1.21							

RYI (relative yield index) = total estimated yield of all species/potential yield.

Total yield = total yield of all species.

Seasonal Totals: W = Winter, S = Summer, T = Total.

Table 5.4 Trends in mean fork length-at-age (cm) with 95% confidence limits for lake trout harvested during the 1981-1984 winter sport fishery on Big Clear, Big Rideau, Big Saloon, Charleston and Devil Lakes.
Values in mean FL-at-age were calculated "at time of capture".

Age	Statistic	Big Clear				Big Rideau				Big Saloon				Charleston				Devil Lake				Standard Growth Curve
		81	82	83	84	81	82	83	84	81	82	83	84	81	82	83	84	81	82	83	84	
III	mean	25.4		22.8	27.3	26.8	31.2	25.1	22.5				24.1	25.7	27.2	28.7		30.5		26.3	24.8	22.3
	CL	1.1		4.9	3.3	3.1	3.8	14.6						1.1	1.4	1.0		5.7		2.2	1.2	
	n	6		3	5	4	2	2	1				1	10	7	4		5		5	3	
IV	mean	25.5	30.8	28.4	29.5	35.1	37.2	34.2	35.1	34.9	33.0	27.7	28.0	32.3	32.7	33.3	31.9	35.1	36.6	31.7	27.9	27.9
	CL	21.0	3.2	1.7	1.7	3.9	1.5	3.1	2.3	3.2	5.1	2.8	1.4	3.4	1.1	1.4	2.2	2.0	2.5	2.4	1.6	
	n	2	11	10	22	7	21	10	15	7	5	7	12	9	24	15	11	15	7	14	13	
V	mean	28.5	35.4	32.9	31.7	43.8	45.0	43.9	39.7	36.4	36.1	33.3	31.6	38.1	43.9	37.7	38.6	39.8	43.6	37.8	34.6	32.9
	CL	0.9	8.2	2.1	1.7	2.7	2.4	2.6	1.7	2.0	41.3	9.4	1.8	1.0	9.7	2.3	1.4	4.2	1.3	5.7	18.7	
	n	11	5	12	18	15	18	18	16	12	2	4	14	19	5	15	20	14	10	6	3	
VI	mean	33.8	44.6	36.3	40.1		53.3	51.6	45.6	35.6	38.6	35.2	36.0	48.2	53.5	45.8	45.1	43.1	46.9	42.4	43.8	39.6
	CL	1.7	15.6	7.7	3.1		4.9	4.2	4.0	5.0	2.0	2.4	6.2	4.9	6.7	2.7	3.8	61.0	6.6	3.5	1.9	
	n	18	7	3	15		12	4	4	4	11	6	6	22	7	7	8	2	3	16	15	
VII	mean	44.1	50.4	39.5	40.2		58.6	55.9	61.4	63.7	42.2	37.4	35.7		63.0	50.3			51.1	48.6	49.7	45.7
	CL	2.2	10.0	24.8	1.1		2.9	5.6		17.6	7.0	2.6	3.0		3.7	9.5			19.8	8.3	2.1	
	n	13	7	3	4		5	8	1	3	6	19	4		6	4			3	6	12	
VIII	mean	54.7	43.1	51.8			63.2	64.7	69.3		57.4	44.5	44.1			53.9	66.9	72.7		51.9	62.0	51.2
	CL	7.2	15.2	8.0			156.3		7.0		25.4	5.7	9.7			19.5		31.1		2.8	41.3	
	n	5	4	6			2	1	2		3	9	5			4	1	2		4	2	
IX	mean				59.9			62.2				54.6	52.2			69.6	73.2		64.2	65.3	66.4	56.1
	CL				15.9			14.6				1.7	8.6						8.0		41.3	
	n				2			2				3	5			1	1		3	1	3	
X	mean												71.8				62.2					60.9
	CL												5.7									
	n												2				1					
Mean Growth Index		96	-	101	98	133	133	127	121	110	98	88	92	116	126	120	115	126	132	110	108	

CL= 95% confidence limit.
n= sample size
Mean Growth Index= mean of growth indices for each age group (ie. observed FL x 100 / Standard Growth Curve FL)
(estimates for each age group were calculated only for cases where 95% CL < 10% of mean)

Table 5.5 The contribution of hatchery origin lake trout to the sport fisheries of Big Clear, Big Rideau, Big Salmon, Charleston and Devil Lakes, 1981-1984. Blank spaces denotes not sampled.

Lake	Year	Hatchery Yield			Percent Hatchery Origin			Return of Stocked Fish (%)		
		W	S	T	W	S	T	W	S	T
Big Clear	81	0.38	0.17	0.55	35.7	42.8	36.5	1.44	0.18	1.62
	82	1.73			52.8			3.36		
	83	0.52	0.00	0.52	55.3	00.0	54.1	2.04	0.00	2.04
	84	0.71			44.1			6.31		
Big Rideau	81	0.21	0.82	1.03	66.6	52.9	58.0	1.20	3.41	4.61
(4.02)	82	0.17			51.7			0.89		
	83	0.28	0.69	0.97	68.6	56.0	62.4	0.78	2.52	3.30
	84	0.21			65.9			1.49		
Big Salmon	81	0.75	0.45	1.20	46.4	21.0	47.3	3.81	1.08	4.99
(2.75)	82	0.55			42.1			2.24		
	83	0.84	0.11	0.72	48.0	25.0	52.9	2.65	0.26	2.90
	84	1.13			58.8			2.57		
Charleston	81	0.24	0.91	1.15	56.0	48.0	52.1	0.75	2.07	2.83
(3.48)	82	0.17			48.0			0.84		
	83	0.58	1.88	2.46	56.0	50.0	52.7	2.22	4.07	6.29
	84	0.65			48.2			1.89		
Devil	81	0.09	0.02	0.11	19.0	40.0	11.5	0.67	0.25	0.92
(3.48)	82	0.02			6.7			0.15		
	83	0.12	0.09	0.21	16.1	4.5	11.0	0.98	0.43	1.35
	84	0.16			9.6			0.56		

Definition of columns:

Yield: number * year.

Hatchery yield = hatchery origin lake trout yield in kg/ha.

Percent Hatchery Origin Trout = number of hatchery origin lake trout harvested/total number of lake trout harvested x 100.

Return of Stocked Fish (%) = estimated harvest of hatchery origin lake trout/total number of lake trout stocked x 100.

Seasonal Totals: W = Winter, S = Summer, T = Total.

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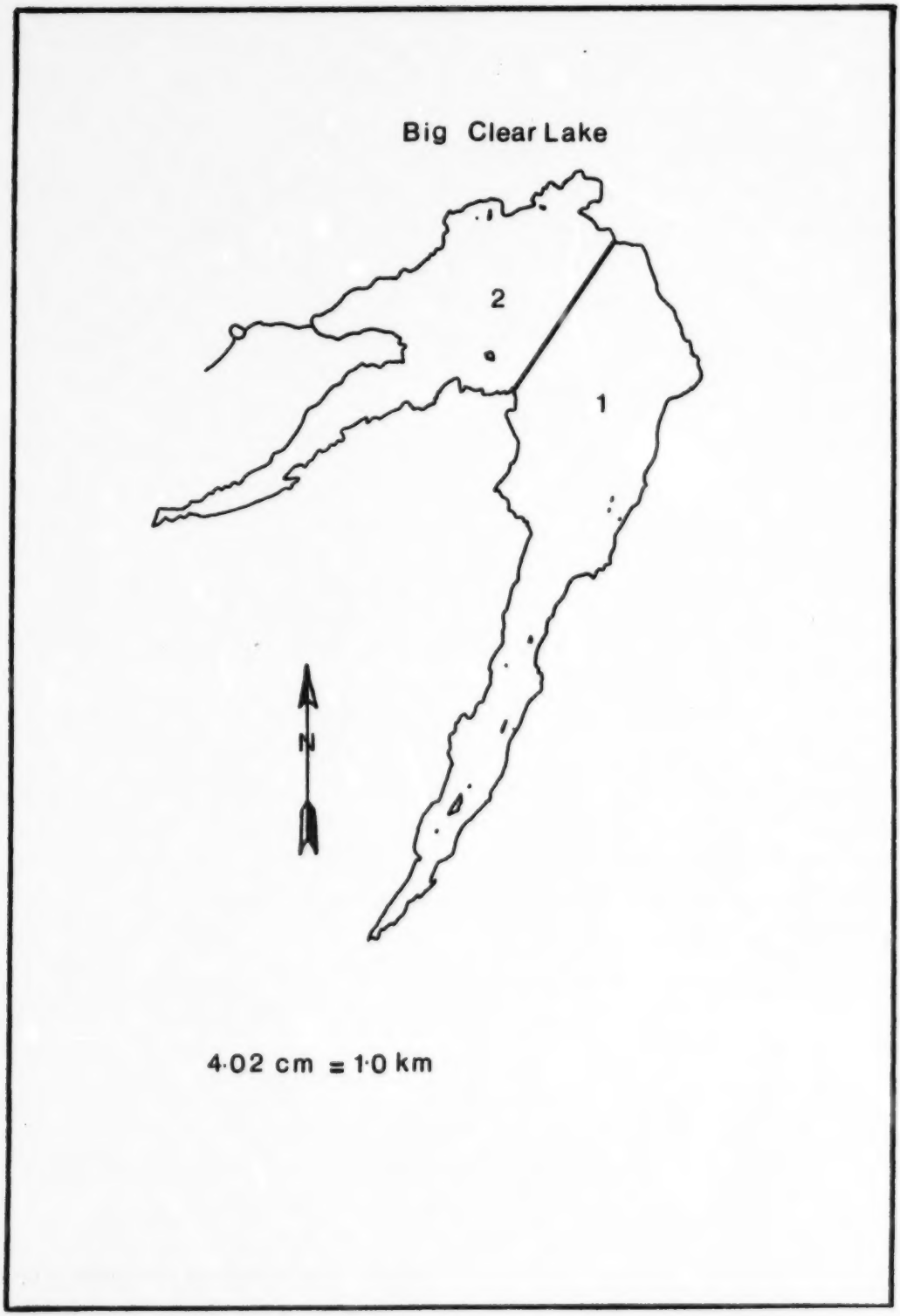
8. APPENDIES

Appendix 8.1 Creel census areas for a) Big Clear, b) Big Rideau, c) Big Salmon, d) Charleston and Devil Lakes.

Appendix 8.1a



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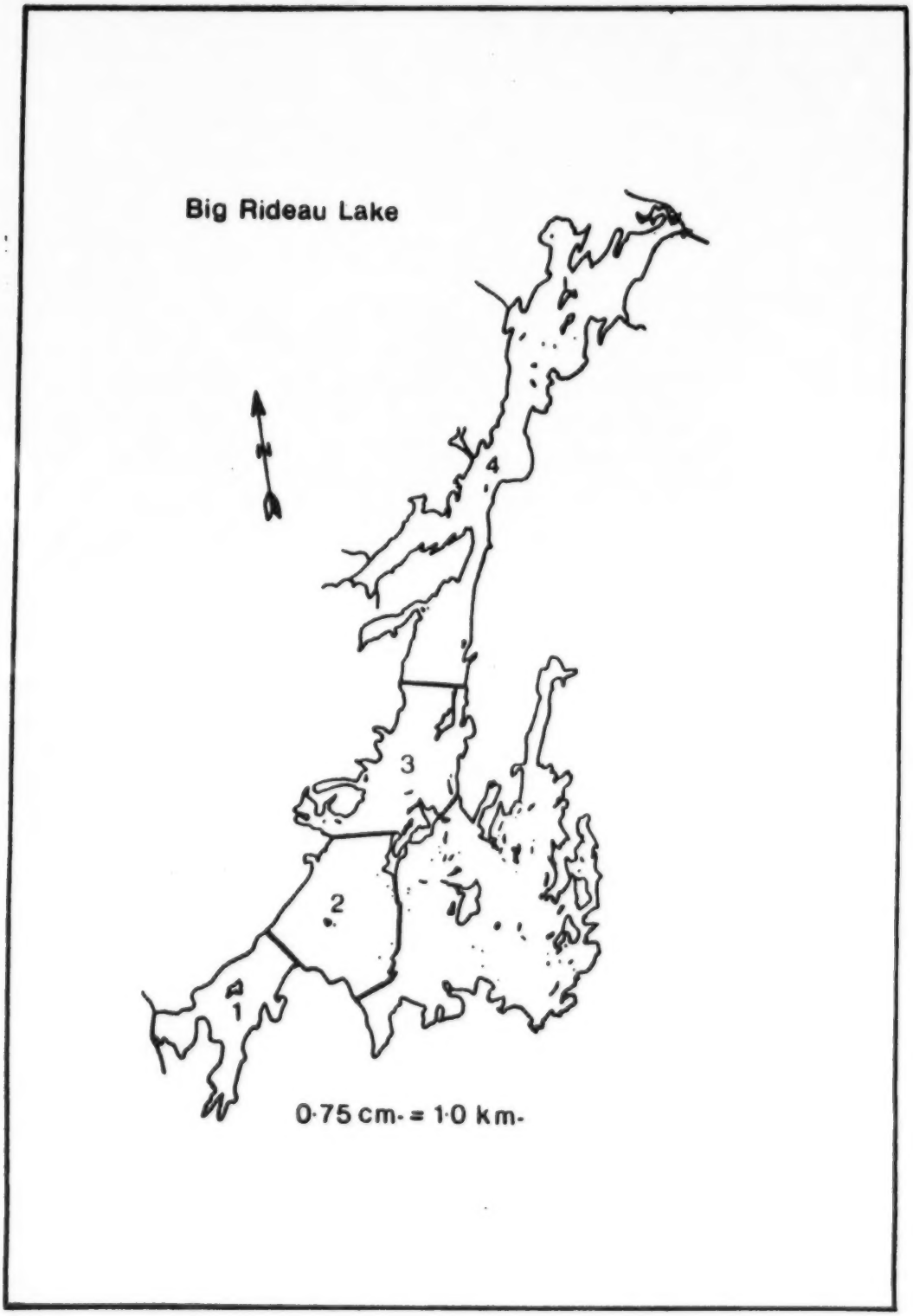

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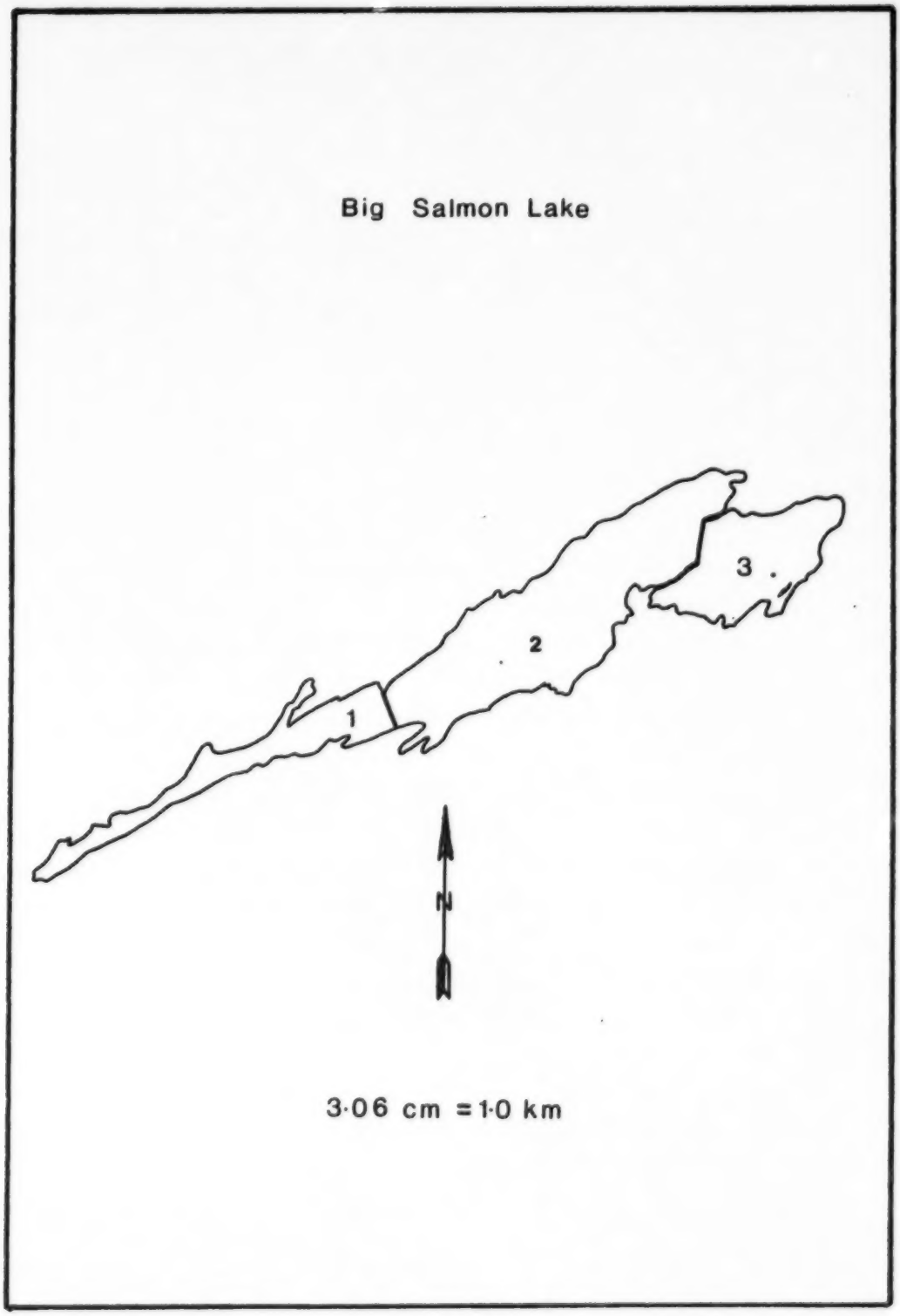

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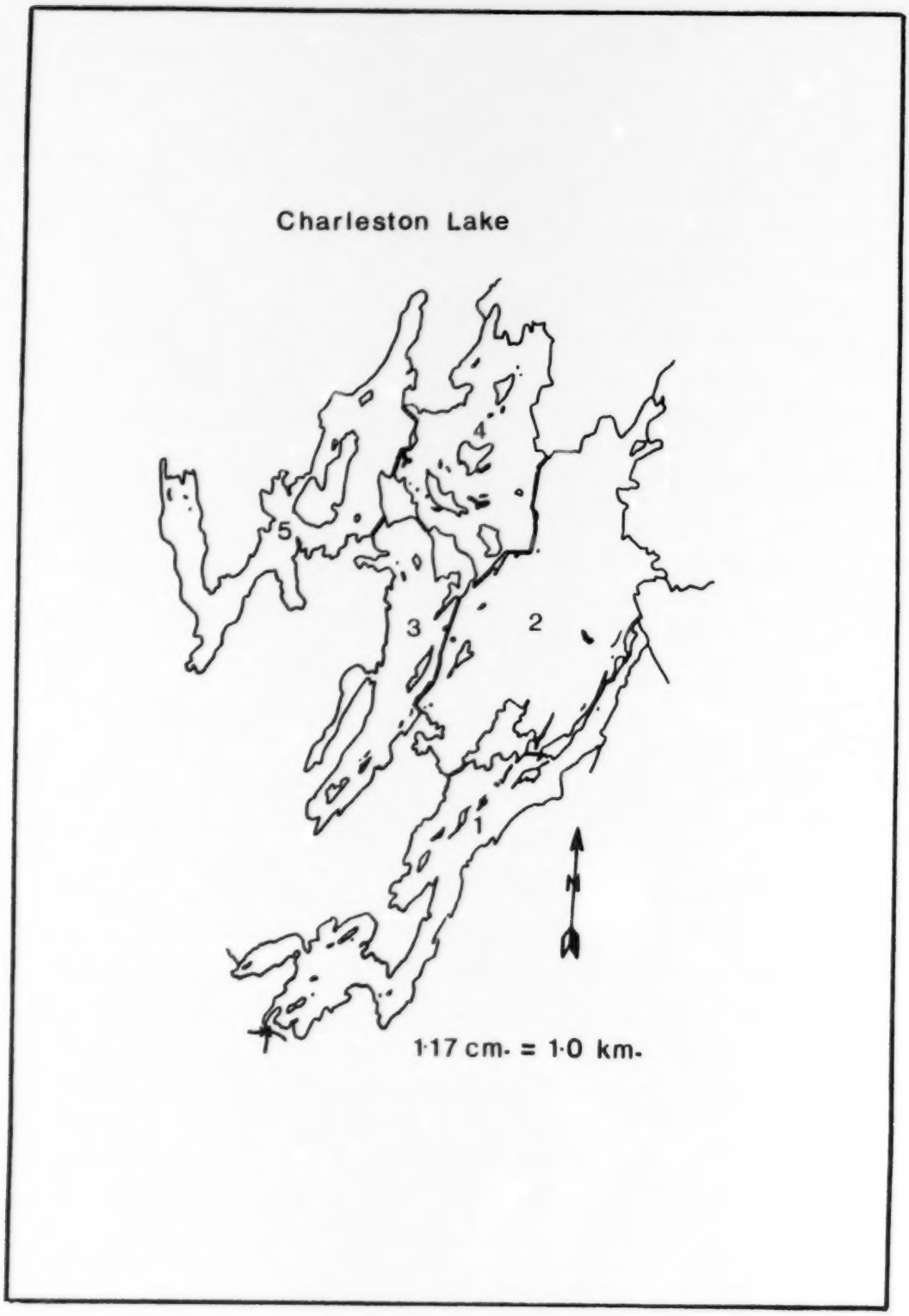

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